

WOULD NVIDIA WORRY? AMD'S NEW GRAPHICS UNVEILED

2100 PC

Aug 2019
Issue 470

YOUR EXPERT
GUIDE TO TODAY'S

TECH
RITY

**COMPUTEX
2019 REPORT**
INTEL & AMD DROP
TUNNING NEW CPUS
CONTROVERSIAL
NEW LAPTOP DESIGNS
INNOVATION AT LAST?
PLUS ALL THE PC TECH COMING
FROM THE MOST SURPRISING
HOW IN YEARS



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**PC builder's
handbook**
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BEGINNERS
Windows 10
May update
HOW TO FIX ITS FLAWS



**HOT TECH
REVIEWS**
NEW VR: **OCULUS QUEST**

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Vigor2926Vac

50x
VPN

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- 4G LTE SIM card slot (L model)
- VoIP with 2 x FXS and 1 x FXO Line Port (V model)
- Object-based SPI Firewall and CSM (Content Security Management) for network security
- Supports VigorACS 2 Central Management System for remote management
- Central VPN Management for 8 remote Vigor routers
- Central AP Management for deployment of multiple wireless VigorAPs
- Free Smart Monitor Network Traffic Analyzer for 30-nodes

Vigor2952 Series

Dual-WAN broadband Fibre Router with Security Firewall, 4 x PoE LAN ports (power budget up to 60 Watts), 100 x VPN tunnels including 50 x SSL-VPN tunnels



Vigor2952P



- 1 x Gigabit Ethernet/SFP combo WAN port, 1 x Gigabit Ethernet WAN port
- Multi-WAN Load Balancing & Failover and High Availability mode
- 4 x Gigabit PoE Ethernet LAN ports with 60,000 NAT sessions (P model)
- Complies with 802.3at Power over Ethernet Plus (P model)
- Supports PoE power up to 30 watts for each port, and total PoE power budget up to 60 watts (P model)
- 1 x USB port (USB3.0) support 3G/4G LTE USB mobile
- 100 x VPN tunnels including 50 x SSL-VPN tunnels with Central VPN Management
- VPN Load Balance and Redundancy
- Object-oriented Firewall with Content Security Management and QoS
- IPv6 & IPv4
- Multi subnet WAN/LAN through 802.1Q
- 1 x USB port (USB2.0) support file sharing, external storage, network printer or thermometer
- Central AP Management; Central Switch Management; Smart Monitor Traffic Analyzer
- Supports VigorACS 2 Central Management System for remote management

Vigor2133 Series

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Vigor2133Vac

2x
VPN

- 1 x Gigabit Ethernet WAN port
- 2 x USB ports for 3G/4G access, FTP server and Network printers
- Load Balance and Failover functions for WAN and USB 3G/4G WAN
- 4 x Gigabit Ethernet LAN ports with 30,000 NAT sessions
- IPv6 & IPv4
- NAT throughput over 450Mbps
- Object-based SPI Firewall, Content Security Management (CSM) and QoS
- 2 x VPN tunnels including 2 x SSL-VPN tunnels
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- SIP VoIP (2 x FXS) for Vac model
- Central AP Management for deployment of up to 2 wireless VigorAPs
- Supports VigorACS 2 Central Management System for remote management
- 2 years back to base warranty



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It's a hot war.

Traditional rivals fight, you win.



Computex is a
battleground. It's
where companies
fight to make the
biggest splash and
drown out any noise
coming from their
competitors. Many
different tactics are
employed so journo

like me can write about what left
the strongest impressions, which in
turn gets your attention here. In
theory. Retail and reseller buyers
are there in force, too, and are much
fawned upon for the potential wins
they can bring.

In years when there is no new
motherboard chipset Computex is
noticeably lower in energy. It is,
after all, the annual PC show and
Taiwan is home to Asus, Gigabyte,
MSI and Asrock. It is true that the
heartbeat of the entire show is the
motherboard.

This year was heaving with X570
activity. There were, I believe, 57
new motherboards launched at
Computex based around the X570
chipset. That's a mighty lift for AMD
and cause for much positivity in the
industry. AMD also played the
tactical game, announcing three
new 3rd-gen Ryzen CPUs at
Computex, but delaying the launch
of its hero 16-core 3950X CPU and
new Navi GPU series (read all about
that on page 68!) until a week later
at E3.

Intel in contrast reminded me –
not for the first time – that its

activities and influence across the
industry extends far and wide. We
all miss the now cancelled annual
Intel Developer Forum (IDF). It was a
week where you could see up close
all of the innovation projects Intel
supports or runs itself. This year at
Computex Intel's presentations felt
like a mini IDF. Particularly
noteworthy were the new form-
factors for laptops and PCs that are
already seeing the light of day as
actual products. My single top pick
of the entire show was the stunning
Asus ZenBook Pro Duo and that
stems from a partnership with Intel.
Read more about that starting on
page 56.

I'm sure once AMD has a string of
healthy and wealthy years under its
belt it will engage in activities like
this that are beneficial to the entire
industry. In the meantime the
battlefield has a new front opening
with Nvidia forced to respond to
AMD's 5700 and 5700XT GPUs. In
next month's APC we'll have a face
off between AMD's new 5700/XT
and Nvidia's response – the Super
series cards, which are really just
slightly tweaked versions of the
existing GTX 2060 and 2070.

It all adds up for a fascinating
time to be an observer, and
rewarding time as a user and
potential customer.

BEN MANSILL

EDITOR

ben.mansill@futurenet.com

exclusive software

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ISSUE 470, AUGUST 2019

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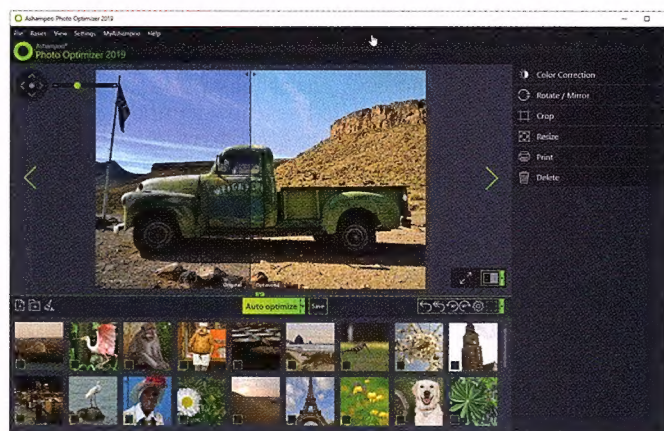
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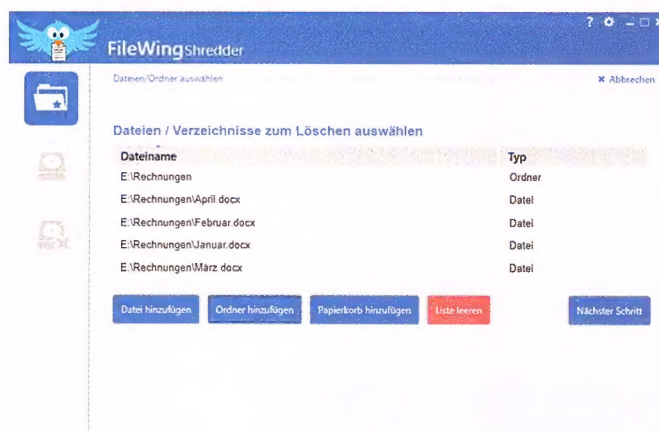
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"AMD came right out of the blocks with a pre-show keynote that set the tone of the entire show and got everyone talking."
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» LATEST REVIEWS



Aorus 15-SA

Aorus steps down off the performance-gaming pedestal and jumps into the entry consumer gaming market.

Aorus has traditionally been a high-end gaming laptop brand, but the company showed that line by releasing an Aorus 15 model with an Intel Core i9 CPU and a Nvidia GeForce RTX 2080 GPU earlier this year. The latest 15-inch gaming laptop from Aorus is now seemingly cutting Gigabyte's grass. The Aorus 15-SA is not only more affordable but it's also running an entry-level gaming CPU. We were disappointed to see a big reduction in material quality of the chassis with a thin, flimsy keyboard surround and a cheap plastic screen bezel and undercarriage. The perforated air vents and angular black-on-black detailing isn't the worst we've seen on a gaming laptop, but the overall design input is markedly less than anything from Aorus in the recent past. The keyboard is a much more springy membrane-style, with a relatively shallow travel distance and the trackpad is overly compact but both do a good enough job to not be offensive. The Aorus 15 is 5mm longer, 4mm wider and 5.5mm thicker than the Gigabyte Aorus 15, which might not sound like much, but it adds up to be 28% thicker overall. It's also 13% heavier at 2.4kg. The Aorus 15 is strapped up by the new 9th generation Intel Core i7-9750H CPU, 16GB of RAM, a 512GB Intel NVMe PCIe SSD and one of Nvidia's latest bang-for-buck cards the GTX 1660 Ti. This configuration is between 10 and 12% more powerful than our averages for Gigabyte and MSI gaming laptops running a Core i7-9750H CPU but this translated to between 11 and 28% boosts in general CPU work and home tasks. As one of the first devices to get a GTX 1660 Ti the Aorus 15 there isn't much to directly compare this device against, but it did seem to perform between 12% and 59% better than the Asus TUF Gaming FX505DU, despite having the same RAM and GPU specifications. Nvidia suggests that the 1660 Ti is roughly three times more powerful than the GTX 1060 and offers between 15 and 52% improvement on GTX 1060 game frames which roughly lined up with what we got. The 1660 Ti showed average fps scores within 10% of devices running RTX 2080s and Max-Q GTX 1070s. So you can expect to get anything between 60fps in Ghost Recon Wildlands and 78fps in Far Cry Primal.

Verdict

Reasonably priced, full HD gaming laptop that is a little too cheap to not benchmark the Aorus brand.

★★★★★

Asus TUF Gaming FX505DU review

A

RACV Smart Home Starter Kit

R

Audeze Mobius

T

Inside APC

Find out all about APC's editorial policies, test practices, how to read the benchmark results, and more.

APC is Australia's oldest consumer technology magazine - having been consistently in print for over 35 years, since our first issue way back in May 1980 - and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer - it's in our name, after all - the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And, like you, APC's journalists want to know what's good in tech - no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and APC aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives - the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in APC are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an APC reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, APC still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in APC, you can assume that higher is better. There are certain tests that deviate from this rule where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.

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www.gigabyte.com/au/Laptop



Windows Terminal now available

THE COMMAND LINE GETS A FRESH NEW LOOK.

Microsoft announced during the Build developer conference in May that it was rethinking Windows 10's command line tool. The new utility, which the company unimaginatively dubbed the Windows Terminal, has now been released as a "very early preview" on the Microsoft Store. The new app features an updated interface with support for custom themes, multiple tabs, and numerous other personalisation options. Because text is such a core part of the app, Microsoft has also included GPU-accelerated text rendering as well as support for multiple fonts and emoji.

AMD CEO Lisa Su named one of world's best

WHILE NVIDIA'S JENSEN HUANG FALLS FROM FAVOUR.

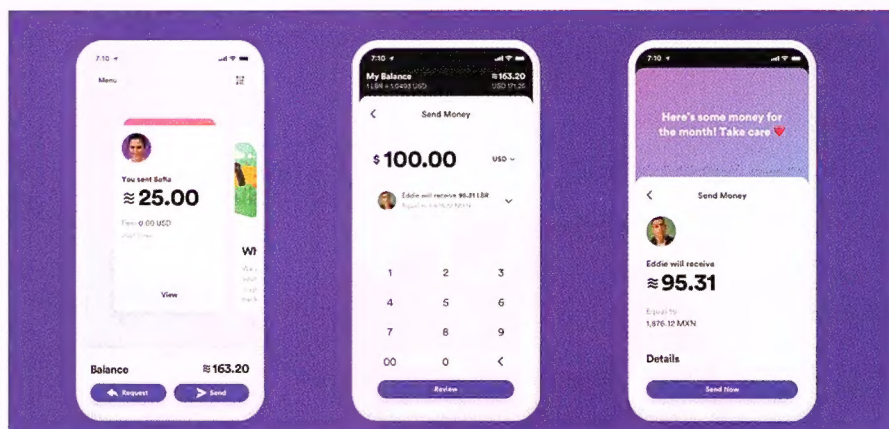
US-based financial newspaper *Barron's* recently released its list of the World's Best CEOs of 2019, in which AMD CEO Dr. Lisa Su is included and prominently featured on both the online publication and on the front page of the magazine. Su is placed on equal ground with CEOs such as Amazon's Jeff Bezos, Disney's Robert Iger, and Microsoft's Satya Nadella. *Barron's* has notably removed Nvidia CEO Jensen Huang from its list, citing poor market performance from Turing products.

Apple design head Jony Ive leaving the company

STARTING OWN DESIGN FIRM, WITH APPLE AS A CLIENT.

Apple Chief Design Officer Jonathan "Jony" Ive is leaving Apple later this year. He will start his own design firm, to be called LoveFrom, which will include Apple as a client. "After nearly 30 years and countless projects, I am most proud of the lasting work we have done to create a design team, process and culture at Apple that is without peer," Ive said in a statement.

Ive defined the modern, white minimalist look of the company's product line, cultivating a style that suggested elite design accompanied by high price tags.



Facebook reveals new Libra cryptocurrency

"BLOCKCHAIN-POWERED" CALIBRA WALLET WILL LAUNCH IN 2020.

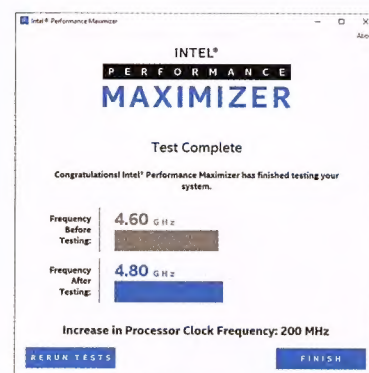
Social media giant Facebook has revealed plans to launch a new Libra cryptocurrency as part of its blockchain-powered Calibra digital wallet, with the latter expected to arrive on Messenger and WhatsApp in 2020. Facebook says you'll be able to send Libra to "almost anyone with a smartphone" quickly and easily, and at a low cost – and the new cryptocurrency can be used for anything from paying for a coffee to riding public transport. While Facebook has promised that Calibra will use verification and anti-fraud processes similar to those currently being used by banks and credit card providers, and that it will be a completely separate subsidiary to Facebook as a social media platform, it isn't without its critics. French Finance Minister Bruno Le Maire said that it was "out of the question that it become a sovereign currency" in a radio interview, raising concerns regarding money laundering, the privacy of its users, and the ability to finance terrorism. Facebook is promising refunds if your account is in any way compromised, and assures its users that account information or financial data won't be shared with Facebook or any third party – although the social media giant admittedly doesn't have a great track record in this field.

Intel offers CPU overclocking tool

ALONG WITH OC INSURANCE!

Intel has at last released an automated CPU overclocking tool. The Intel Performance Maximizer is a free download that currently supports 9th-gen i9-9900K/KF, i7-9700K/KF and i5-9600K/KF CPUs. Support for additional CPUs will be added later, we're told. The tool also requires a Z390 motherboard, although many users have reported it works perfectly on earlier Z370 boards. The app is very particular about having certain BIOS settings in place, too, so be sure to read the release notes before giving it a run. Later versions will offer per-core granular overclocking, but for now it applies an across the board CPU frequency increase.

Even more remarkably, Intel is also offering special warranty support for overclocked CPUs. For a one-off fee of US\$19.99, Intel's Performance Tuning Protection Plan will replace any covered CPU that is damaged by overclocking during the standard warranty period. We never thought we'd live to see the day when Intel offered overclocking insurance, but here we are. We'll be testing the tool and will report on our findings soon.



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Linux gamers take note: Steam support for Ubuntu in doubt

THANKS TO CANONICAL'S CHANGE OF STANCE ON 32-BIT PACKAGES.

Ubuntu-maker Canonical has been forced to do an abrupt about-face, after Valve has announced that it will no longer support Steam on the popular Linux distro. Ubuntu was set to drop support for 32-bit packages in its upcoming 19.10 release, but after Linux gamers revolted and Valve chimed in, the OS devs have backtracked. Valve will no longer name Ubuntu as "the best supported" Linux platform for Steam, however.

Huawei pulling back from laptop market?

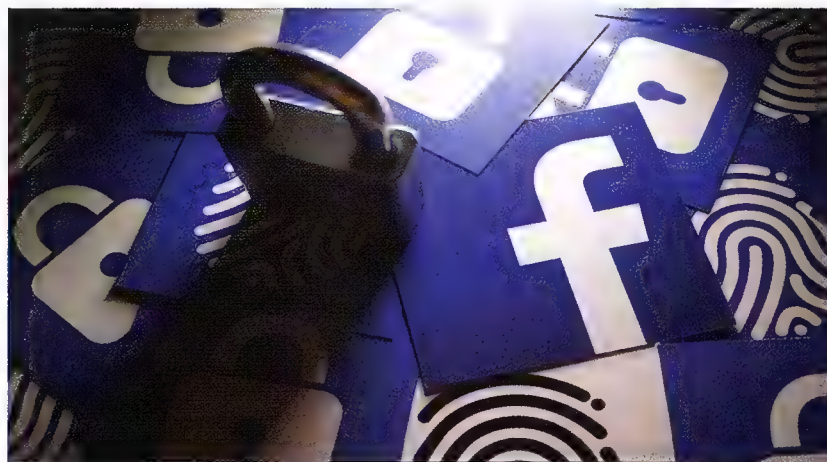
SO SOON AFTER ENTERING IT...

According to a recent *DigiTimes* report, Huawei has told its upstream laptop components suppliers to suspend their deliveries to the company. The reported move comes after Huawei lost access to Intel and AMD's processors, as well as Microsoft's Windows operating system. Without Windows licenses, access to Intel and AMD chips or a Windows-alternative in the pipeline, Huawei seems to have had no choice but to suspend its laptop business.

Cybercrooks built their own VPN to hack into global telcos

UNPRECEDENTED ATTACK ON OVER A DOZEN TELECOMS BEGAN IN 2012.

Last year, the *Cybereason Nocturnus* team discovered an advanced, persistent attack targeting global telecommunications providers. These bad actors still control the network today and have even built a VPN for their convenience. The hackers have been infecting multiple mobile carriers in Europe, Asia, Africa and the Middle East since 2012 and they reportedly used their control of these networks to steal hundreds of gigabytes of data on customers.



Social media bots no longer need to hide to be effective, says Facebook

THE GREATEST FEAR IS FEAR ITSELF.

Internet bots are a touchy subject these days, especially when it comes to social media. How many of that celebrity's Twitter followers are real people, and how many are fake? Who in the comments section of that Facebook post has a genuine opinion to share, and who is just trying to send a debate into disarray? The answer isn't always clear – and according to Facebook's head of cybersecurity policy, Nathaniel Gleicher, it's that uncertainty that's likely to cause trouble in the coming years. Gleicher spoke on the subject of online security at the 360/OS conference in London, saying that organisations attempting to destabilise online debate – and influence the outcome of political elections – would no longer have to conceal their efforts to be successful. At this point, with the public eye so squarely aimed at potential meddling, drawing attention to bad actors' own methods was likely to spread fear and distrust across online platforms. According to Gleicher, that means, "Not running a large network of fake accounts, but just playing on the fact that everyone thinks there are large networks of fake accounts out there."

AMD and Samsung announce new GPU partnership

IS RADEON ON A SMARTPHONE COMING?

The two companies made a surprise announcement in June, revealing a multi-year strategic partnership in which Samsung will license AMD's graphics IP. While the crucial details remain secret, it looks like AMD and Samsung are setting up for a rather unique collaborative arrangement. We've known for some time now that Samsung has been working on its own GPU design, making it so far as to producing test chips on 10nm and 7nm fabs. While we don't have detailed information, it does look that things haven't been progressing quite as fast as Samsung had hoped.

From all perspectives, it looks like this AMD/Samsung deal was only recently finalised, and that the two companies are just at the start of their partnership. This also means that whatever Samsung started working on, it's going to take some time to bring it to market. Even if this is a crash program, it will still take Samsung some time to integrate AMD's GPU IP and tune it for SoC performance and power levels. That would seem to be a minimum of two years, if not longer, so we're not expecting to see Radeon-powered Samsung SoCs any sooner than 2022. ■

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RYZEN
AMD



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Huawei ban: the global fallout explained

How serious are the issues facing Huawei, and how does it affect you?

Huawei has found itself at the centre of a global tussle between the US and China after the Trump administration placed the Chinese brand on the 'entity list', limiting the business US companies could do with it, with global implications. It led to Google blocking Huawei's future access to Android updates, UK-based chip designer ARM has ceased all activities with the brand, and multiple retailers and networks around the world have had to stop dealing with Huawei for fear of sanctions from the US government.

Huawei has been granted a temporary license to continue its US dealings while negotiations are ongoing, but this only lasts until August 19 and it's unclear how the company will be able to regain access to its US partners while the government considers it a threat to national security. The temporary permit hasn't seemed to lead to a rekindling of efforts from companies like Panasonic or Microsoft, and more brands are following suit. That now includes the Wi-Fi Alliance and the SD Association, the standards-making bodies that govern the technology used for connectivity and mobile storage. Ejecuting Huawei from these means the company can play no part in shaping the future of these technologies – although it will still be able to use them.

What does the ban mean if I have a Huawei phone?

It will remain secure and updated for the foreseeable future.

Perhaps the most useful piece of information about current Huawei phones is Google's statement issued to Future Publishing: "We are complying with the order and reviewing the implications. For users of our services, Google Play and the security protections from Google Play Protect will continue to function on existing Huawei devices," a spokesperson told us.



That's good news if you've just spent large amounts of money on a Huawei P30 Pro: as alluded to above, current devices from the Chinese brand will continue to get security updates and access to the Play Store for the foreseeable future, as Google has promised not to leave those out in the cold.

So while the fact remains that current models will still be offered essential software updates, it's unclear how long these will last for, and the fact networks are already getting jittery about the sanctions isn't going to make anything easier for Huawei.

While most smartphone brands will honour security updates for two to three years after launch of a new handset, one might expect this to be much shorter in the case of Huawei phones, given these restrictions from Google.



How about future Huawei phones?

Features and business flexibility will likely be impacted.

The move from Google means the tech giant will no longer work with Huawei directly on issuing updates to its OS, and it can't give the Chinese company access to the Google Play Store. This is a potentially critical blow to the Asian brand, which only recently was touting its plans to become the world's largest smartphone manufacturer.

This means that if Huawei wants to keep using the Android operating system, it will need to use the Android Open Source Platform (AOSP), which is the free framework system that any brand can use as an underlying foundation for its products.

However along with the Google Play Store, it won't have access to the core Google apps like YouTube, Google Maps and Chrome – these are all elements of Google's business that aren't part of AOSP. Without access to the Play Store, Huawei would be forced to work directly with developers to get them to publish versions of their wares to its own Android app store, AppGallery.



What of the ARM news, is it truly damaging?

It could be a killer blow.

A huge issue facing Huawei is that chip designer ARM isn't going to work with the brand for the short term. That may seem odd, as it's a Japanese-owned brand headquartered in the UK, but as its designs use US-based technology, there's a fear this could fall foul of the trade restrictions.

If the Huawei ban means it can't use ARM reference designs in its chipsets, it would be incredibly difficult and costly for the brand to replace them – and it may prove to be impossible, which would cast further doubt over the future of Huawei's phone arm.

The blows keep coming, with Intel and AMD now cutting ties, along with Western Digital, which extends the potential impact to Huawei's newly launched laptop line. ■



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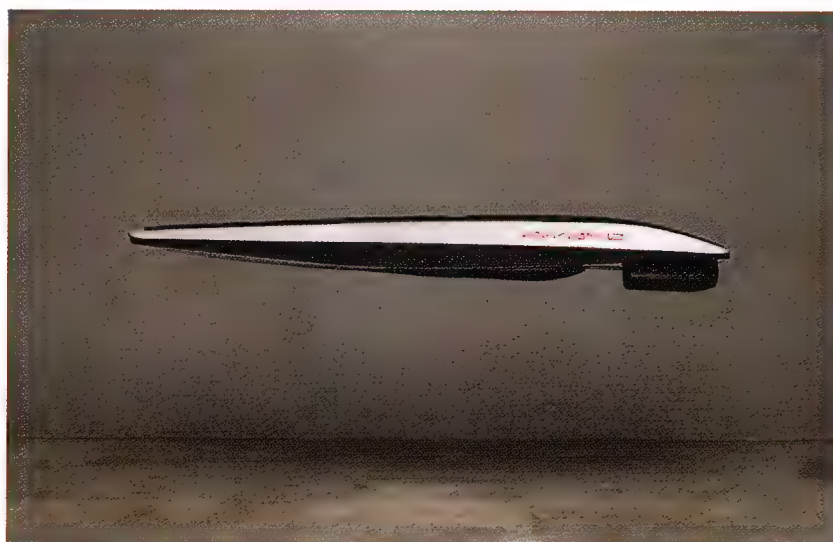
» JOEL BURGESS GATHERS THE GOOD GEAR

KAT LOCO

A VR tracker with a kick.

US\$139 | KATVR.COM/LOCO

The Oculus Quest (see our review on page 28) has cut the wires on room scale VR, but the six degrees of freedom only extends to your hands via the Touch controllers. KAT Loco is a Kickstarter hoping to get its foot in the VR door by... well, putting your feet in VR. Three remote sensing devices attached to each of your ankles and your waist record relative movement in order to translate it into room-scale steps in VR. This supposedly universally-compatible VR accessory is promising to allow you to do things like run backwards or strafe while shooting, and to look in a different direction to where you are moving.



AWAKE RAVIK ESURFBOARD

Electrify your surfing setup.

€18,900 | AWAKEBOARDS.COM

Batteries can now power bikes, cars, homes and even some personal aircraft, so why not surfboards too? The Ravik Electric Surfboard from Swedish startup Awake works like a self-powered wakeboard, but it looks more than capable of shredding some small beach breaks, too. With a top speed of around 56km/h, this carbon-fibre water-carving machine looks like a lot of fun, but the battery life is only 40 minutes so if you can afford to drop close to 30 grand on a personal watercraft, you might also want to invest in a few additional batteries.

CREATIVE STAGE AIR

Raising the sound bar on PCs.

\$69.95 | AU.CREATIVE.COM

Soundbars have gotten to a point where their convenience and size make them the preferred option in many lounge room setups, but Singaporean multimedia company Creative wants to see if the soundbar works as well alongside a PC monitor as it does the TV. Sliding in at 41cm long, the Creative Stage Air is compact enough to tuck under any monitor bigger than 28-inches and while we imagine most people will keep it plugged in, it also has a 2,200mAh battery with a 6 hour playback lifespan for a wire free soundscape. The two 5W speakers can be connected via 3.5mm audio jack or Bluetooth 4.2.





NINJA FOODI

This ninja does more than fruit.

\$400 | WWW.NINJAKITCHEN.COM.AU

Ninja cut its teeth creating 'bullet' style blenders which slice off some of the time and effort in smoothie making, but the company has decided to expand its repertoire with a new multi cooker called the Ninja Foodi. The Foodi is a pressure cooker-cum-air-fryer that's designed to speed up the pace of slow cooking and oven baking without losing any flavour. Whether you want to halve the time it takes you to braise beef or pull pork, or you're keen to crisp up your own chicken or potato chips, this multi-cooker seeks to make it all simpler set-and-forget cooking.

ARLO DOORBELL

An app-connected intercom.

\$119 | WWW.ARLO.COM

If you've ever missed a package being delivered at your house or you've always wanted a home intercom but could never justify the cost of getting someone in to install it, then prepare to be excited by the Arlo Doorbell. Arlo is a Netgear spinoff that went public in 2018 thanks to the success of its battery-operated wireless security cameras, and this new video doorbell will slot neatly into any existing Arlo security system. You can set the doorbell up to alert your phone (whether you're home or not) and provide a video feed of an accompanying camera, while the Arlo Chime plugs into the wall and alerts anyone at home.



PARROT MAMBO FPV

Put yourself in the pilots seat.

\$169 | WWW.PARROT.COM

Drones can be designed for two main purposes; cinematography or fun, and if you're more intrigued by the latter half of that equation then flying in first person view (FPV) is one of the most mindblowing experiences you can have with a drone. Usually, the combo of a VR headset, a controller and a speedy drone would set you back a thousand or more dollars, but you can get the Parrot FPV for as little as \$169 locally. While it might be priced like a cheap toy, the Mambo drone is actually exceptionally well crafted, offering sturdy components and responsive controls. ■

how it's done



This charger's layout could be similar to the Gear S3 charging dock, which provides 700mA of output current at 5V.



We can pop out the 3.85V battery – with its 472mAh offering 1.81Wh – with our finger.

Samsung Galaxy Watch

Surprisingly fixable.

In the age of Galaxy smartphones and tablets, Samsung adds a Galaxy Watch to its universe. There was already some gear floating in space, forming a belt around the Samsung sun, but a few months ago, this new celestial body emerged. Today we'll go where no tinkerer has gone before, and probe the depths of this timepiece with a teardown.

MAJOR TECH SPECS

- 1.3-inch (33mm) circular Super AMOLED 360 x 360-pixel display (1.2-inch/30mm on the smaller 42mm version)
- Dual-core, 1.15GHz Exynos 9110 processor
- 1.5GB RAM and 4GB internal memory (768MB RAM for the Bluetooth version)
- Wireless charging and 5ATM IP68 water resistance
- 472mAh battery (270mAh for the 42mm version)

KEY FINDINGS

- A quick survey reveals twin mechanical buttons on one side, with a small hole for the mic. On the far side, we spot three holes for the

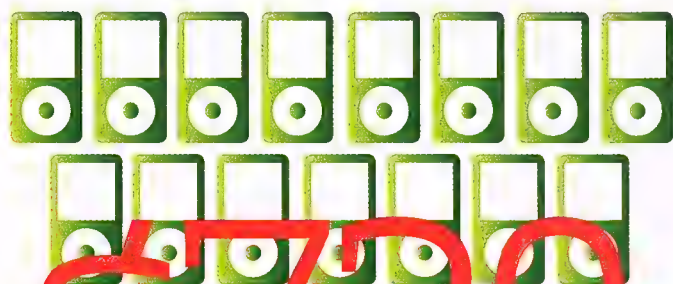
loudspeaker. There's also a heart rate sensor cluster at the bottom, plus a small opening on the rear, possibly for a proximity sensor or pressure valve.

- The standardised 22mm arms are easy to detach, and reveal access to a five-pin port. Is that a USB+1 for emergency wired charging and service? Equipped with our Precision Bit Driver with swivel cap, we tackle the tri-point screws, which seem to be attracted by three magnets that handle docking to the wireless charging stand.
- Expecting a booby trap, we're surprised by the long ribbon cable connecting the heart rate sensor to the internals. The blue rubber seal around the Galaxy's edge might need replacing before reassembly, if damaged, but there's no glue so far. We also spot rubber gaskets for the mic, ambient light sensor, and pressure sensor.
- After disconnecting the display, this nucleus separates into a few smaller elements. There is still no sign of glue. The display's flex cable carries the ambient light sensor, which peeps through a small hole in the display. The display on our 46mm version has a diameter of 33mm.

- The computational center looks like a bug's head, with two button cables as antennae. There's little else on this side, save for two blocks of resin. Structural integrity comes from a midframe, which also houses the power source.
- We return to the back cover in search of satellite components. Equipped with a halberd spudger, we probe the heart rate sensor and NFC antenna. The four photo cells of the heart rate sensor are gathered around the light source. The last parts to come out are the service port and the loudspeaker, held fast by two Phillips screws, with a rubber gasket for ingress protection.
- Repairability score: 8 out of 10 (10 is the easiest to repair). Display repair is prioritised. No overlapping design of cables, no fragile ZIF connectors. Despite being water-resistant, the opening procedure is straightforward and glueless. The battery only uses mild adhesive, but the motherboard must be removed for access. A lot of components are modular, so can be replaced separately – except for the twin button cables. The glass digitizer and screen are fused together – meaning a full replacement is quick and easy, but glass-only repairs are impractical. ■

numbercrunch

» WE LOOK AT THE NUMBERS DRIVING THE BIG TECH NEWS.



\$730 MILLION

AMOUNT OF MONEY SPOTIFY IS PLANNING TO SPEND ON PODCAST-RELATED ACQUISITIONS THIS YEAR – FROM SIGNING UP PODCASTERS TO BUYING APP STARTUPS. THE MOVE CERTAINLY MAKES SENSE: THE INTERACTIVE ADVERTISING BUREAU RECKONS THE PODCASTING INDUSTRY WILL BE WORTH \$1.5 BILLION A YEAR BY 2021.

9

HOURS OF REAL-WORLD BATTERY LIFE ACHIEVABLE BY FUTURE LAPTOPS THAT ADHERE TO INTEL'S PROJECT ATHENA CONCEPT. Project Athena is the successor to Intel's 2012 Ultrabook program, which many PC makers went on to emulate.



3.5K



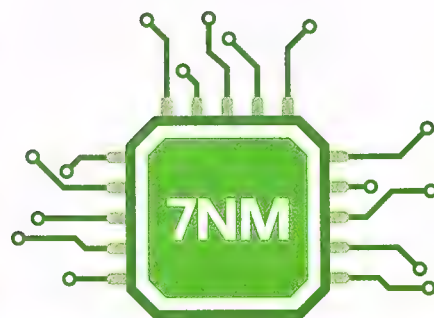
NUMBER OF XBOX GAMES THAT CAN ALREADY BE STREAMED BY XCLOUD WITHOUT DEVELOPERS NEEDING TO MAKE ANY CODING CHANGES.

xCloud is Microsoft's forthcoming games streaming service, and is being built to compete with Google Stadia.

100

NUMBER OF TITLES YOU'LL SOON BE ABLE TO PLAY WITH AN XBOX GAMES PASS SUBSCRIPTION ON YOUR PC – A HUGE INCREASE OVER THE 20 OR SO AVAILABLE THROUGH PLAY ANYWHERE NOW.

Microsoft says it's signed up 75 developers so far, although it hasn't announced which titles will be available, or when, or for how much. More details should have been revealed by the time you read this.



7NM

PROCESS SIZE OF AMD'S THIRD-GENERATION RYZEN CPUS, WHICH ARE GOING ON SALE IN JULY.

The real crowd-pleaser is the Ryzen 9 3900X, which features 12 cores and 24 threads, with a base frequency of 3.8GHz and a boost speed of 4.6GHz. It'll cost a staggeringly affordable US\$499. AMD also has a 16-core CPU for US\$749.



250MPH

SPEED AT WHICH VISITORS ATTENDING THE LAS VEGAS CONVENTION CENTRE (LVCC) WILL SOON BE ABLE TO ZIP AROUND THE VENUE USING AN UNDERGROUND TRANSPORTATION SYSTEM.

The \$70 million project is being built by Elon Musk's The Boring Company and will use high-occupancy autonomous electric vehicles (AEVs), based on Tesla's Model X. ■



Computex. Still the one

Chris Szewczyk reflects on a whirlwind 2019 Computex.

Computex. It's the annual showcase of the entire PC industry and it's one of the most important events we attend, if not the most important. Vendors all jump at the chance to show off their wares, with booths competing to be the biggest, boldest and brightest. This year there was a clear trending theme of catering to content creators, with subtlety, discrete performance and refinement being a refreshing change over gamerfied Optimus Prime-style products. A refreshing change.

We touched down in Taipei on the Monday morning that the show began its week-long run, after an overnight flight from Sydney that was surprisingly comfortable thanks to a lovely China Airlines Airbus A350. There was no time to rest as after dropping into the hotel, it was off to AMD's eagerly awaited keynote, where

the tone was set for the entire show. There, AMD lit a fuse for the whole week with new CPUs, a motherboard chipset, graphics cards, enterprise behemoths and the world's most powerful supercomputer. If you're going to bet big, why not bet the house.

That first event couldn't be matched by the likes of Nvidia. It seems like Team Green made the smart decision to keep it low key in the face of AMD's industry- and consumer-pleasing announcements.

This year was notable as the first couple of days were surprisingly cool. In contrast to the usual 30° plus and very humid weather, we were greeted by overcast conditions and cool breezes. This is definitely a relief for us Australians coming from cool winter climes. Yes there was a bit of rain, but tropical downpours are their own unique experience.

Taiwan is a real hidden gem. If you

ever get the opportunity to visit there, do try to take it. The food is magnificent, it's not too difficult to get around if you know a half dozen key Mandarin words and it's surprisingly affordable. It has a very rich culture with plenty to do for the young and old.

Many tech journalists, particularly those who come from outside Asian time zones, tend have a love/hate relationship with Computex. I sympathise with them. I ended the week with sore feet, not enough sleep, too many trinkets to fit in the bag on the way home and a nasty cold or flu, but that's Computex. I wouldn't have it any other way. Well, I'd gladly live without the cold and flu.

Stray thoughts: Once again Taitra, the organisers of Computex did a magnificent job. The convention halls are run with military precision by well-trained armies of staff.

Trying to think while anywhere near the G.Skill booth was impossible, when it has its MC shrieking at the crowd non-stop at maximum volume, let alone have a meeting in an adjacent booth. Come on guys, please turn the volume down a little.

I feel sorry for the show girls, many of whom adorn many stands. The Taiwanese have no issue with it but I think in the west we're progressing beyond that. ■

"AMD lit a fuse for the whole week with new CPUs, a motherboard chipset, graphics cards, enterprise behemoths and the world's most powerful supercomputer."



Facebook has just become a very dangerous playground for Australian media

A judge has ruled media companies are responsible for user comments on Facebook, Shaun Prescott writes.

For many media companies, social media is a capricious ally: in order to disseminate content, it's increasingly important – nay, necessary – to have a substantial following on platforms like Facebook and Twitter. In an era when these sites serve as homepages for many users, the bulk of users are more likely to “click through” from a social media platform than they are to access content from the homepage of a media outlet.

Over the last decade, media companies have poured money and resources into bolstering their social media presence. This usually involves parsing Facebook's constantly changing and ambiguous algorithms: sharing content isn't as easy as posting a link on Facebook and expecting a response commensurate with the public's interest: there are many factors at play, most of which are understood only by Facebook itself. It's possible to share a big story and have only a handful of people see it, due to some inscrutable aspect of Facebook's inner workings. Or else, sometimes a seemingly

insignificant story will attract decent numbers. As someone who also works in online media, it's sometimes like communing with a moody beneficiary.

So in 2019, media companies are constantly battling to make the best of a confusing situation. But it just got worse for Australia's media: much worse. Last month, New South Wales supreme court judge Stephen Rothman ruled that media companies will be regarded as the “publisher” of user comments on their Facebook accounts. What that means is that the *SMH*, to name one example, will be liable for defamatory comments made under stories it posts on Facebook. According to the judge, companies should be responsible for moderating comments pre-publication, however Facebook doesn't have any such moderation tools.

The ruling relates to the case of Dylan Voller, a former detainee of the Don Dale youth detention centre which sparked a royal commission into police brutality. He sued *The Australian*, *Sydney Morning Herald* and *Sky News Australia* due to defamatory comments made in 2016 and 2017 on Facebook

posts published by these outlets.

The debate at hand isn't whether Voller deserves justice or not. The question is who should be held responsible for defamatory comments on Facebook: the platform holder, or the companies which are increasingly required to use that platform? Even if Facebook was responsible, defamation is hardly an offence which could be policed by algorithm. And for media companies, they'll likely be forced to spend more on moderation, using tools which... don't actually exist.

Speaking to *The Guardian*, social media lawyer Paul Gordon said that “the judge recognised there is no in-built system on Facebook that allows you to prevent the publication of comments on Facebook prior to it becoming public.” But that said, “he also found it would be possible to create a filter using commonly used words like ‘and’, ‘he’, ‘she’, ‘but’, in order to capture most posts. And that's what he said media organisations should be doing, duct-taping together a filter using common words.”

Well, good luck with that. ■

END USER

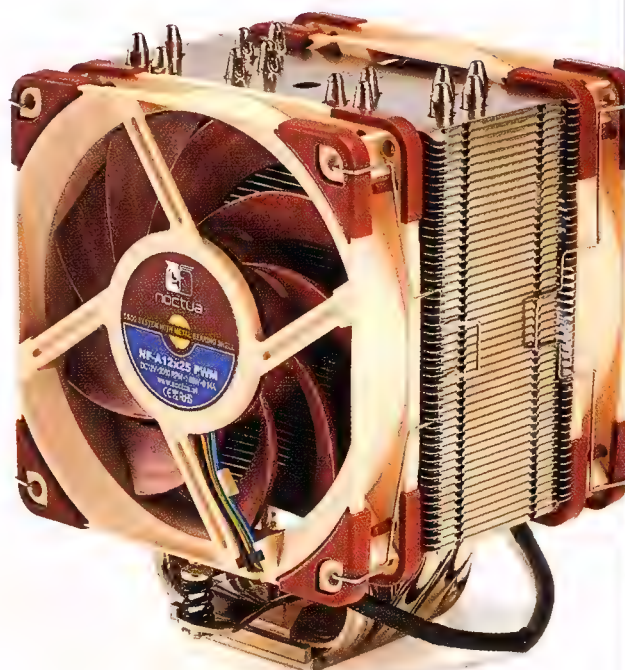
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Air cooling **vs** all-in-one **vs** custom loop water cooling

Which CPU cooler tech is right for you?

High-performance computing is all about keeping cool. But what's the best way to achieve that? Air cooling is the default, while water cooling is often seen as the gateway to maximising performance. But is that true? What's more, if you're considering water cooling, are pre-built AIO (all-in-one) coolers the best bet? Or can you get better performance from a custom closed-loop solution? Of course, performance may not be your only consideration. Ease of use, longevity, and even looks might be on your radar. Time to find out how to keep cool.



Round 1

LOOKS

There are some pretty nifty looking air coolers. Big, bold coolers with hefty heatsinks, oversized fans, and more LEDs than you can shake a SATA cable at. Heck, you can even get air coolers with programmable LEDs that you can sync with other elements of your build, such as case lighting, keyboards, and mice. Air coolers that make a visual statement? Not a problem.

But for sheer visual clout with a sci-fi vibe, nothing competes with a slick custom closed-loop water-cooling installation. What's not to like about gleaming pipes full of brightly colored coolant? Of course, much depends on your specific implementation. A really great-looking custom water-cooling install is costly and complex. Moreover, a shonky build won't just look cheap, it could be a recipe for disaster.

As for AIO coolers, you might think they don't stand a chance from a pure styling perspective. After all, most are at best functional – even agricultural-looking items. Typically, you're looking at a large black radiator, a couple of rubber hoses, and the CPU bracket. Not exactly sexy. On the other hand, if neat and tidy is your aim, AIOs can deliver a really nice no-nonsense solution.

Round 2

VALUE

With high-performance PCs, the law of diminishing returns tends to apply. The more you spend, the less you get in terms of performance uplifts. CPUs are a classic example. Intel will sell you a very nice six-core chip for well under half the cost of some of its eight-core models. The latter are faster, but not enough to justify the price premium.

The same applies to cooling. The best bang-for-buck is something like a \$20 air cooler. Sure, it won't enable the kind of clock speeds that more expensive solutions unlock. If you care about maintaining the lowest possible temps, you need something pricier, too. But for virtually no cash, you get better performance than the likes of a standard Intel cooler can provide. And even compared to the most expensive cooling kit, the computing experience is indistinguishable much of the time.

That said, AIO solutions are very affordable. \$80 buys you a single-fan solution from one of the bigger brands. And, it's a component you can typically use for multiple builds. So, it's a worthwhile long-term investment. As for custom water cooling, going cheap is a scary prospect for PC reliability, so the value proposition is simply poor.

Round 3

INSTALLATION

Air cooling seems like the simplest solution when it comes to installation. Most coolers are compatible with a range of modern CPU sockets, so at most it's a case of choosing the right bracket, maybe fitting that bracket, slapping on some heat paste, then bolting everything down.

The exception comes with larger and more aggressive coolers. For starters, big coolers that spread out from the socket can come into conflict with the RAM sockets. Broader compatibility with cases can also be an issue.

All-in-ones rarely present problems regarding motherboard components. So, it largely comes down to case compatibility. However, most AIOs conform to standardised 120mm and 240mm form factors that are provided for by pretty much any decent case. The exception to that is some small form factor cases, which can limit your options for using AIO solutions.

As for custom water-cooling loops, they're by far the most difficult to install. In theory, their configurability and scope for customisation allows for a wide range of compatibility. In practice, however, it can be both hard work and a little hit and miss.

WINNER:
CUSTOM LOOP WATER COOLING

WINNER:
AIR

WINNER:
TIE: AIR AND ALL-IN-ONE



Round 4

LONGEVITY AND MAINTENANCE

For simple, worry-free operation over the long haul, air cooling is a great option. Worst case scenario: You'll want to whip the cooler out once a year and give it a thorough clean to remove dust and restore full cooling efficiency.

Given the relative complexity of an AIO cooler, you might assume high maintenance levels, but that isn't necessarily so. They're designed to be much lower maintenance than custom water cooling. They're pre-filled and sealed from the factory, with no need to refill, flush, or monitor levels. In that sense, maintenance levels match that of an air cooler. You just need to dust off the radiator now and then. Reliability over the long haul, however, is more questionable. With both fans and a pump, there's more to go wrong.

As for custom water cooling, forget it – it's far higher maintenance. Levels have to be checked, and the system may need periodic topping up. Full-on disassembly for flushing and cleaning may also be necessary; in fact, it's recommended. Likewise, with far more parts, many of them user-assembled, there's way more that can go wrong. If you want an easy life and perfect long-term reliability, don't go with a custom water loop.

WINNER:
AIR (BY A WHIFF)

Round 5

PERFORMANCE

Air cooling might deliver the best bang for your buck, but it isn't the most effective cooling solution on offer. That's water cooling. But does AIO or a custom loop perform best?

You might think there's little in it. Both pump water through a CPU block that offers the same contact with the CPU's heat spreader, right? Yes, but flow rate makes a difference, as does radiator size and efficiency, the fans attached to it, and all that jazz.

Most AIOs fall into two categories: 120mm models with a single fan, and 240mm items with dual fans (triple-fan models are also available). There's some variation in design and efficiency, but they're largely known quantities with predictable performance. Custom loops are a whole different ball game.

In theory, there's no limit to how much water you can pump or the size and number of radiators and fans. At the very top end, then, custom cooling offers the most potential. You can specify more powerful pumps, larger radiators, and more fans. Actually achieving better cooling performance versus a quality AIO cooler, of course, will depend on getting your design, implementation, and installation just right...

WINNER:
CUSTOM LOOP WATER COOLING

And the winner is...

Spotting the victor in our head-to-heads is usually pretty easy. A quick scan of the category winners makes it obvious enough. But not this time. The all-in-one water-cooling solution didn't take a single category outright, yet it's our pick of the three options.

That's because it's a very strong all-around solution. It's not the cheapest, but it remains affordable, especially if you consider that a good AIO kit should last long enough for multiple PC builds. What's \$50 to \$100 over a couple of builds? Exactly.

AIO coolers are also dead easy to use. They're compatible with virtually all motherboards, the vast majority of PC cases support them, and they're a cinch to install. They also provide cooling performance that only a really complex and costly custom-loop water-cooling kit would exceed.

In fact, the only area where AIOs are unambiguously off the pace is in terms of visual bling. But if you prefer a low-key and functional look, or you don't care about that aspect, an AIO is now the obvious all-around choice for performance PC enthusiasts.



GAMING LAPTOP

\$2,399 | WWW.AORUS.COM

Aorus 15-SA

Aorus steps down off the performance-gaming pedestal and jumps into the entry consumer gaming market.

Aorus has traditionally been Gigabyte's outlet for its top-specced gaming laptops, but the company blurred that line by releasing an Aero 15 model with an Intel Core i9 CPU and a Nvidia GeForce RTX 2080 GPU earlier this year. The latest 15-inch gaming laptop from Aorus is now, seemingly, cutting Gigabyte's grass; the Aorus 15 is not only more affordable but it's also running an entry level gaming CPU.

We were disappointed to see a big reduction in material quality of the chassis, with a thin, tinnie keyboard surround and a cheaper plastic screen bezel and undercarriage. The perforated air vents and angular black-on-black detailing isn't the worst we've seen on a gaming laptop, but the overall design input is markedly less than anything from Aorus in the recent past.

The keyboard is a much

"The latest 15-inch gaming laptop from Aorus is now, seemingly, cutting Gigabyte's grass."

more springy membrane-style, with a relatively shallow travel distance and the trackpad is overly compact; but both do a good enough job to not be offensive. The Aorus is 5mm longer, 4mm wider and 5.5mm thicker than the Gigabyte Aero 15, which might not sound like much, but it adds up to be 29% thicker overall. It's also 13% heavier at 2.4kg.

The Aorus 15 is propped up by the new 9th generation Intel Core i7-9750H CPU, 16GB of RAM, a 512GB Intel NVMe PCIe SSD and one of Nvidia's latest bang-for-buck cards the GTX 1660 Ti. This configuration is between 10 and 12% more powerful than our averages for Gigabyte and MSI gaming laptops running a Core i7-8750H CPU, but this translated to between 11 and 29% boosts

in general CPU work and home tasks.

As one of the first devices to get a GTX 1660 Ti the Aorus 15 there isn't much to directly compare this device against, but it did seem to perform between 12% and 39% better than the Asus TUF Gaming FX505DU, despite having the same RAM and GPU specifications. Nvidia suggests that the 1660 Ti is roughly three times more powerful than the GTX 960 and offers between 15 and 50% improvement on GTX 1060 game framerates which roughly lined up with what we got. The 1660 Ti showed average fps scores within 10% of devices running RTX 2060s and Max-Q GTX 1070s. So you can expect to get anything between 42fps on Ghost Recon Wildlands and 78fps on Far Cry Primal

using Ultra 1080p settings. This makes the GTX 1660 Ti a good enough graphics card to utilise the 15.6-inch 144Hz IPS panel on most games using 'High' FullHD settings.

The Aorus 15-SA is currently on sale for \$2,399 which is pretty much in the middle of the road for devices with RTX 2060 GPUs, so while it is much cheaper than what we're used to from Aorus, it's not particularly competitive in the entry gaming laptop space. ■ Joel Burgess

Verdict

A reasonably priced FullHD gaming laptop that is a little too cheap to not besmirch the Aorus brand.





GAMING LAPTOP

\$1,592 | WWW.ASUS.COM/AU/

Asus TUF Gaming FX505DU review

Asus partners with AMD and Nvidia to throw another hardball at the budget laptop gaming scene.

Asus launched its TUF Gaming laptops last year as a reengineered entry level gaming laptop for those wanting a little more durability at an affordable price point. A year later this is still the message, but the revamp has a number of new features that make it stand out in other ways too. Top of this list is a new set of AMD Ryzen CPUs that deliver similar performance for a considerable price cut. Backing this up is the inclusion of Nvidia's latest GTX 1650 and 1660 GPUs, which jettison the ray tracing and DLSS perks introduced on the 20-series RTX GPUs to get near 2060 performance with another solid price cut. If that wasn't enough, the device also has a 120Hz 15.6-inch screen for super smooth gaming and it's even included a whole new suite of MIL-STD810G military

certifications for durability against shocks and extreme temperatures, humidities, altitudes and solar radiation exposure.

At first glance, without any of this background knowledge, you might think the design of the TUF FX505DU Gaming laptop was nothing special, but peel back the facade and these vents have been designed for function not form. The 'Anti Dust Cooling' system introduced on last year's models returns to spin out any particles that would otherwise be flushed through your laptop, and while the membrane keyboard is a little mushy, it's not bad for typing and is tested to last in excess of 20 million keypresses, double the industry standard.

The TUF FX505 can be fitted with either an Intel Core i5, Intel Core i7, AMD Ryzen 5 or an AMD Ryzen 7, but we couldn't see the lower end Intel option ranged

anywhere locally. The Core i7 model comes with either 8GB of RAM and a GTX 1050 GPU for \$1,299, or you can pay \$100 extra and get 16GB of RAM and a GTX 1050 Ti GPU. The FX505DD, DU or DT models come with various combinations of the Ryzen 5-3350H or Ryzen 7-3750H CPUs, either 8 or 16GB of RAM, one of the three GTX 1050, 1650 or 1660 GPUs, and either 256GB or 512GB of PCIe SSD storage. The AMD models start at \$999 for the DD and range up to \$1,592 (\$1,699 RRP) for the DU.

While AMD's Ryzen processors may have the core count edge when it comes to PC CPUs, the notebook versions are only quad-core arrangements, which means there's a considerable cut in raw power against Intel's hexa-core chips. On Cinebench's R15 Multi-threaded benchmark the FX505DU got 782, 29%

lower than our average for devices running an Intel Core i7-8750H. Interestingly though, last year's TUF FX504 scored an almost identical 752, despite running a Core i7-8750, so we're guessing part of the decision to move to a less powerful processor was because the device doesn't have the cooling capacity to fully utilise that Intel CPU.

The New TUF FX504 also offers a much better battery life at three hours and 12 minutes compared to the FX504's one hour and 51 minute lifespan on PCMark 8's battery benchmark. ■

Joel Burgess

LABS BENCHMARK RESULTS

PCMARK 8 - HOME (SCORE)

ASUS TUF GAMING FX505DU	3385
ASUS TUF FX504	3595

HWBOT X265 1080P (AVG FPS)	
ASUS TUF GAMING FX505DU	18.593
ASUS TUF FX504	21.249

CINEBENCH - MULTI-THREADED CPU

ASUS TUF GAMING FX505DU	782
ASUS TUF FX504	752

3DMARK FTIME SPY (SCORE)

ASUS TUF GAMING FX505DU	4,760
ASUS TUF FX504	2,525

GHOST RECON WILDLANDS - ULTRA 1080P (FPS AV)

ASUS TUF GAMING FX505DU	36.76
ASUS TUF FX504	22.96

TOTAL WAR: WARHAMMER 2 - ULTRA 1080P (FPS AV)

ASUS TUF GAMING FX505DU	45.3
ASUS TUF FX504	23.5

CRYSTALDISKMARK READ (MB/S)

ASUS TUF GAMING FX505DU	1679.8
ASUS TUF FX504	492.3

CRYSTALDISKMARK WRITE (MB/S)

ASUS TUF GAMING FX505DU	982.5
ASUS TUF FX504	163.7

Verdict

The TUF FX505DU makes some critical improvements on its predecessor and cleverly cuts costs.





SMART HOME

\$295 | WWW.RACV.COM.AU

RACV Smart Home Starter Kit

Samsung SmartThings-based home automation and security sensors.

RACV is known for being an automobile club, but its Home Division has become the exclusive Australian distributor for Samsung SmartThings products. The Smart Home Starter Kit consists of a Wi-Fi hub, three motion sensors and two 'general purpose' sensors which monitor door and window status plus temperature and vibrations. They can be used as a basis of home automation and monitoring or for security.

Installation is simple and involves plugging the hub into your router, downloading the Samsung SmartThings app and using QR codes to install the sensors. The sensors communicate with the hub via Z-Wave and Zigbee wireless technology which uses significantly less power than Bluetooth and Wi-Fi. Battery life isn't

stated but similar devices can last years before a change is required.

Our hub comfortably communicated with a sensor two floors up but if you're in very-large premises you can install additional hubs to boost range. The app encourages you to organise sensors into different rooms and connect any other smart home devices including TVs, speakers, smoke alarms, carbon monoxide alarms, flood sensors and light bulbs. Despite being part of Samsung's ecosystem, as with most smart home technology, everything can communicate with competing hardware to at least some degree.

If you don't have any other smart devices you can immediately set the sensors up in a security configuration. The SmartThings app's Smart Home Monitor pre-set provides options to arm

everything for when home or away or disarm it – all with one touch. When armed at home, events which trigger the sensors are logged and flagged but if armed when away, you'll get multiple notifications that you can't ignore. Pre-set options include dimming lights or changing their colour, sounding sirens or broadcasting notifications via speakers. You can also be prompted to activate the system when you leave your home as determined by your phone's location. If you want to give other users access to settings, you can do so via their Samsung account. The app walks you through everything.

At the core of the automation features lie 'If x then y' commands. The SmartThings app provides many options for this which it calls Conditions and Automations. These can be triggered by sensors, time of day and smartphone

location and do things like turn on the lights when you enter a room (or you're near home) or set mood lighting according to a command or trigger. For more options you can install the IFTTT (If This Then That) app which has a huge community and many pre-built applets to help add the likes of Google Assistant, Alexa and Router controls to your home.

At \$295 it's cheaper than the sum of its components and is a great smart home entry point. Just remember these are fundamentally trigger devices and you'll need additional hardware to make the most of them. ■

Nick Ross

Verdict

Good value and a simple set-up make this a great platform for any budding smart home.



"If there's gunfire directly ahead and you turn your head to the left, the gunfire shifts to the right speaker. It does so precisely and naturally."



GAMING HEADPHONES

\$599 | AUDEZE.COM

Audeze Mobius

The best gaming headphones in the world.

These are exceptional gaming headphones – the best I've ever used – for two big reasons. Three, actually, if you include the price, which appears ridiculously high but is actually remarkably low, all things considered.

First, these are planar headphones. Unlike regular cans or speakers with a speaker cone and magnets at its base, planar types vibrate a perfectly flat and very thin (100nm for the Mobius) circular sheet of material. This sheet typically is nearly the same size as the speaker cups, has an electric conductor (super thin wires) weaving across the sheet, and it's vibrated by a series of carefully placed magnets on either side. The advantages are virtually instant response – so sounds are tight and accurate – and the audio is far cleaner than you get from a vibrating cardboard cone. Plus,

planar can handle far greater volumes without distortion.

Only recently have planar headphone prices fallen below \$1,000. They've been multi-thousand dollar audiophile gear for a very long time, and Audeze has been one of the better planar brands, so it's well down with the technology. These are the first gaming headphones to use planar technology, as far as I'm aware.

So, for game sounds they're spectacular and do double duty as a stunning music device. So, that's partly why I think they're great value.

The second big win is that these really are gaming headphones, in the most incredible way. Using 'NX' technology from professional movie and TV audio company Waves, they create a 3D positional effect that both simulates a spatial 3D audio environment and maps your head's position

within it. The magic is the last bit. It uses sensors that poll 1,000 times a second and as you move your head, and the positions of the various sound sources change with it. If there's gunfire directly ahead and you turn your head to the left, the gunfire shifts to the right speaker. It does so precisely and naturally. Move a tiny bit, and the sound position adjusts proportionally and correctly.

It creates unbelievable immersion but there are tactical advantages, too. Hear faint footsteps somewhere? Look towards the sound and, ahh yes, they must be behind that rock I'm now staring directly at. I sim race a lot using triple screens; as a car comes alongside and I glance at it the sound moves with me as if I were in a real car. It's magical and wonderful.

Now, moving your head around in a game is unusual unless you're in

VR or using TrackIR, it's just not something most people do. But if you have a large widescreen monitor or multiple monitors like a triples setup, suddenly there is application for this technology. A set of EQ modes is also provided for different game types, or none at all with pure high res mode for music.

The only downside is they're battery powered, being good for about 10 hours between charges, and won't work at all (even for music) when it's flat. But that's an insignificant price to pay for access to such astonishing technology. These are, literally, game changers. ■ Ben Mansill

Verdict

3D sound has long been a gaming gimmick, but these do it authentically and bring head tracking technology.





VR HEADSET

64GB, \$649; 128GB, \$799 | WWW.OCULUS.COM

Oculus Quest

Is Oculus's new standalone VR headset the future of VR gaming?

VR has been readily available for the past few years now and while many people have experienced some form of VR, the initial expense of a headset and a capable PC is still far beyond the means of the majority of those who want one. The just-released Oculus Quest headset offers an entirely mobile VR experience – one that doesn't need to be driven by a powerful PC, dedicated gaming console or expensive smartphone to work – and it costs a reasonably-affordable \$649 to get great quality 'drive-away' VR.

The headset is powered by a Qualcomm Snapdragon 835 processor – the top of the line 2018 mobile processor that was used in many of last year's flagship smartphones, like the US version of the Samsung Galaxy S9. While there are more recent processors available, they're also far more expensive – the 835 is the sweet spot in terms of price vs performance. That

processor is supported by 4GB of RAM and either 64GB or 128GB of onboard flash storage, which is more than enough to get you running some impressive VR experiences.

What's perhaps one of the biggest drawcards of the Oculus Quest is its new six degrees of freedom tracking – allowing you to move forwards, backwards, side to side and vertically, as well as the usual three axis of rotation. This new freedom is facilitated by four wide-angle cameras which sit on the four front-facing corners of the headset, and track the relative motion of the room. Having onboard tracking for horizontal and vertical movement might not seem like such a big deal, but it opens up a whole new arena of games to this untethered device.

At launch the Oculus Quest managed to pick up compatibility for massively popular titles like *Superhot VR*, *RoboRecall* and *Moss* and even introduced impressive new ones like *Star Wars: Vader Immortal*.

These titles look amazing on the 1,440 x 1,600 pixel-per-eye displays, and the 72Hz screen kept motion exceptionally smooth across all the launch titles we tested. We spent plenty of time in the headset and, with the exception of a few questionably designed games, we experienced absolutely no motion sickness. This is a testament to just how good the gyroscopes and motion sensors are, and highlights the fact that the processor never stuttered under the load of the games it was being tested with.

We were actually extremely impressed with the OS overall. It offers a seamless experience and looked as good as what you get on the Rift. While it's actually comfortable to browse the Oculus library through the headset, you don't actually have to put it on in order to grab a game. The Oculus app allows you to browse purchase and begin downloading apps for the headset directly from your phone (a feature that

was sorely missed in Samsung's Gear VR Oculus app). The app also includes excellent features like an inbuilt casting mechanism so that you can project the experience onto a monitor or TV for others to watch.

It all adds up to makes the Oculus Quest a much more social device. It's no problem to clear a small space in your (or a friend's) living room, then use the headset to set up a new boundary and include a whole group of people in the experience by casting it on the big screen.

The Quest obviously doesn't have access to the full library of Rift games at launch, but it has way more genuinely appealing titles than any other VR headset we can think of out-of-the-gate. ■ Joel Burgess

Verdict

Oculus Quest is the most affordable and convenient VR system we've yet seen. A great entry-point headset.





MONITOR

£TBA | ASUS.COM

Asus ROG Swift PG35VQ 35-inch 21:9 Monitor

All hail the new king of high end ultra-wide gaming monitors.

On paper the Asus ROG Swift PG35VQ is excellent, with all the right specs and features any hardcore gamer could desire. 35-inch curved panel, 3440x1440 resolution, 200Hz refresh rate, G-Sync support, DisplayHDR 1000 certification – you couldn't ask for more. All those wonderful specs don't come cheap, so let's take a look to see if the PG35VQ is worth the big bucks.

Without turning the monitor on you can tell that this is a flagship Asus product. The stand isn't a flimsy plastic thing, but is sturdy and includes a set of LED light covers to project different images out of the base onto your desk. Three of the covers are blank, presumably to etch your image into. The PG35VQ has a large light up logo on the rear too that along with the projection LED in the base, is fully customisable via the

Aura Sync software platform.

Turning the monitor on and it's obvious from the viewing angles alone that the PG35VQ is a VA-type panel. This is a fine compromise to make for a gaming monitor, as most of the time you're going to be sitting dead centre whilst playing a game and a VA panel allows for the PG35VQ's insane 200Hz refresh rate.

The PG35VQ is factory calibrated and supports up to 90% of the DCI-P3 colour gamut, which when combined with 512 zone dimming so only the areas that need to be bright are lit up and DisplayHDR 1000 certification, games with HDR support like *Shadow of the Tomb Raider* and *Hitman 2* look absolutely amazing.

Rounding out the panel's features, there's Nvidia G-Sync Ultimate support to keep things looking smooth

in all circumstances, plus a blue light filter and flicker free technology to protect your eyes.

Being a gaming monitor, the PG35VQ includes a suite of features it dubs "GamePlus" that are enabled in the monitor's settings. It overlays gaming specific items like a permanent crosshair dead-centre, a timer and an FPS counter. GamePlus is far from a killer feature, but it's nice to have.

Also packed in the PG35VQ is a hi-fi-grade ESS 9118 digital-to-analogue converter (DAC). It gets used when you plug a pair of 3.5mm headphones into the monitor and send audio from your PC to the monitor over HDMI or DisplayPort or connect the monitor to your PC over USB 3.0. It's supposed to sound better than the built in DAC on most PCs, but if you've dropped the

cash to get a fancy monitor like this you probably already have a decent sound setup.

There's no doubt that the Asus ROG Swift PG35VQ is a bloody great monitor. High resolution, deep and rich colours, fast refresh rate – it's wonderful to game on, particularly if your favourite titles have HDR support. At the time of publication, Asus hasn't announced Australian pricing, but overseas the PG35VQ sells for around AUD\$4,000. That's massive coin for a monitor, but it's the price you pay for greatness. ■ Anthony Agius

Verdict

Massive price but for that you get the ultimate gaming monitor available today.





MONITOR

\$TBA | ASUS.COM

Asus Designo Curve MX38VC 37.5" Monitor

A big and curvy, feature packed monitor that looks great on a desk.

Those looking for a no-frills monitor that displays a great image and nothing else can move on to the next review in this magazine, as the Asus Designo Curve MX38VC is more than just a monitor. It's a sound system, a phone charger and an art piece that takes pride of place on your desk.

The MX38VC has an IPS panel with 99% sRGB colour gamut coverage that's factory calibrated. For general purpose computer use (non-pro photo editing, web browsing, office apps, software development), it's great and most users would have no complaints regarding image quality. That said, at this price point it would be nice to include some level of VESA DisplayHDR certification.

Coming in at 37.5-inches, the MX38VC is unlike most other 21:9 monitors in this size range, sporting a 3840x1600 resolution. That

little bit of extra vertical resolution (most are only 1440 high) is a nice touch. The MX38VC's subtle 2300R curve is less pronounced than the 1800R commonly seen on 21:9 monitors, so you can sit a little further back to find the viewing sweet spot.

Where the MX38VC comes into its own are the non-display related features. Built-in to the base is a 15W Qi charger, so you can simply place your Qi compatible device (e.g. smartphone, headphones, external battery pack) on the MX38VC stand and charge it up. It's very handy and makes you wonder why more monitors don't include this feature as standard.

Also built-in to the MX38VC are speakers that have been developed by Harman Kardon in conjunction with the "Asus Golden Ear Team" (that's not a joke) and work with "Asus SonicMaster audio

technology" software to try and make built-in monitor speakers that don't suck. They succeed in jumping over that low bar and the built-in speakers sound about the same as a sub-\$100 2.1 unit. Great for reducing clutter on your desk, but that's it.

Some other nice touches on the MX38VC is Bluetooth support that allows the monitor to be used as a wireless speaker by your smartphone or tablet, even when the monitor is in standby mode. Laptop users will appreciate that the MX38VC can be hooked up via USB-C that can receive a DisplayPort signal and 60W of power over a single cable. There are even gamer-centric features like an FPS counter, permanent crosshair and timer. Like most modern monitors, the MX38VC includes a TUV Rheinland blue light filter to protect

your eyes.

The Asus Designo Curve MX38VC exists not to blow other monitors out of the water with its image quality or value for money, but with features you might find useful in a general-purpose setting. The built-in speakers get the job done, Bluetooth music streaming and the built-in 15W Qi charger are handy but they don't make up for the fact this is an expensive monitor (approximately \$1,500 at time of printing) that lacks the image quality you'd expect from a monitor at this price. ■ Anthony Agius

Verdict

Very nice to use and with an abundance of luxury extras.



software

» APPS FOR ALL YOUR PLATFORMS



Windows SOFTWARE

UWP Companion (beta)

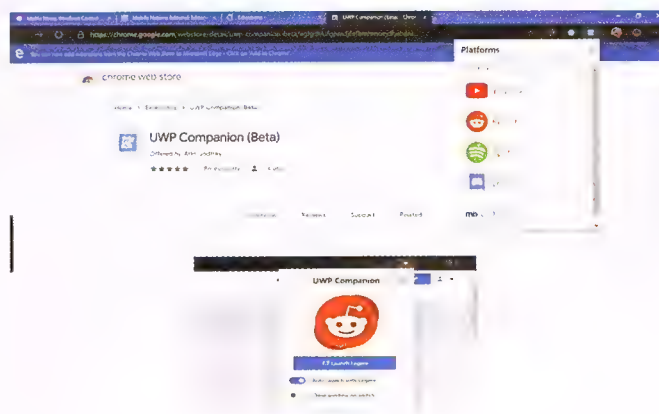
An excellent companion to anyone who uses third-party applications for YouTube, reddit and other popular platforms.

FREE | [TINYURL.COM/APC470UWP](https://tinyurl.com/APC470UWP)

UWP Companion allows you to open links from anywhere on your PC in dedicated third-party apps. It currently supports myTube (YouTube), Spotimo and Xpotify (Spotify), Mixplay (Mixer), Legere and Redplanet (reddit), and Quarrell (Discord). If you open a link to one of these sites, you can have them open the link inside the third-party application. Clicking a link does open a new tab on your default browser, but there's an option to have that tab automatically close once the third-party app is launched.

This is a clever way to get around the fact that many sites don't support Windows 10's 'Apps for websites' feature, and is also a way to get around the fact that many websites and apps are made by third-party developers. The downside to UWP Companion is that it only works with a small library of apps right now. Developers can opt to have their apps added to this list, but it's relatively small at the moment. You can elect to have links open in third-party apps for YouTube, Spotify, Mixer, reddit, and Discord, but that's it. These are good third-party apps, and in many cases are the best third-party app for their respective service, but the lack of options is a bit disappointing.

If you use any of the apps that work with UWP Companion, you should absolutely use it. It makes it easy to jump into myTube when you follow a link from Twitter or jump into a



Spotify playlist on Spotimo when you open a link from a friend. Even though the app is in beta, we didn't run into any issues and think many users would be happy with it as is.

Hopefully, over time, more sites will support 'Apps for websites' by default, and more apps will support UWP Companion. It's an impressive addition to Chrome or the developer versions of Microsoft Edge. **Sean Endicott**

Bitdefender Antivirus Plus 2019

ONE OF THE BEST ANTIVIRUS SOLUTIONS THAT COMES WITH A VPN, SAFE BANKING TOOLS AND SECURE REMOVAL OF MALWARE THREATS.

\$70 | [BITDEFENDER.COM.AU](https://bitdefender.com.au)

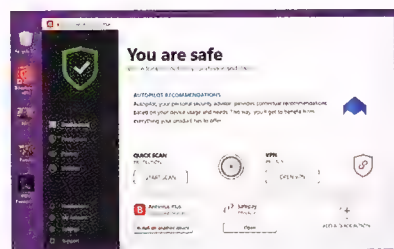
From the first time we started testing Bitdefender we were impressed. This antivirus software stops malicious files before they have a chance to start downloading. In fact, Bitdefender often beat the browser notifications asking us to verify the download, displaying a large warning message and securely removing the threat. Bitdefender recognised the URL of where threats were hidden and let us know those sites were tagged as malicious, too, so we could avoid them. It easily caught phishing schemes, including those designed to look like Facebook and PayPal account logins.

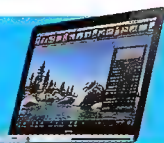
We allowed several threats to infect our test computer, then used Bitdefender to find and clean them. Bitdefender did an excellent job finding each one. In fact, often during our testing, we would reinstall Bitdefender to gather up threats other antivirus software left behind because we were that confident in its protection ability. Each removed threat was securely and completely cleared from our PC so there was no chance malware could reinfect.

We have no problem recommending Bitdefender because we've seen how quickly it stops malware before it has a chance to start downloading.

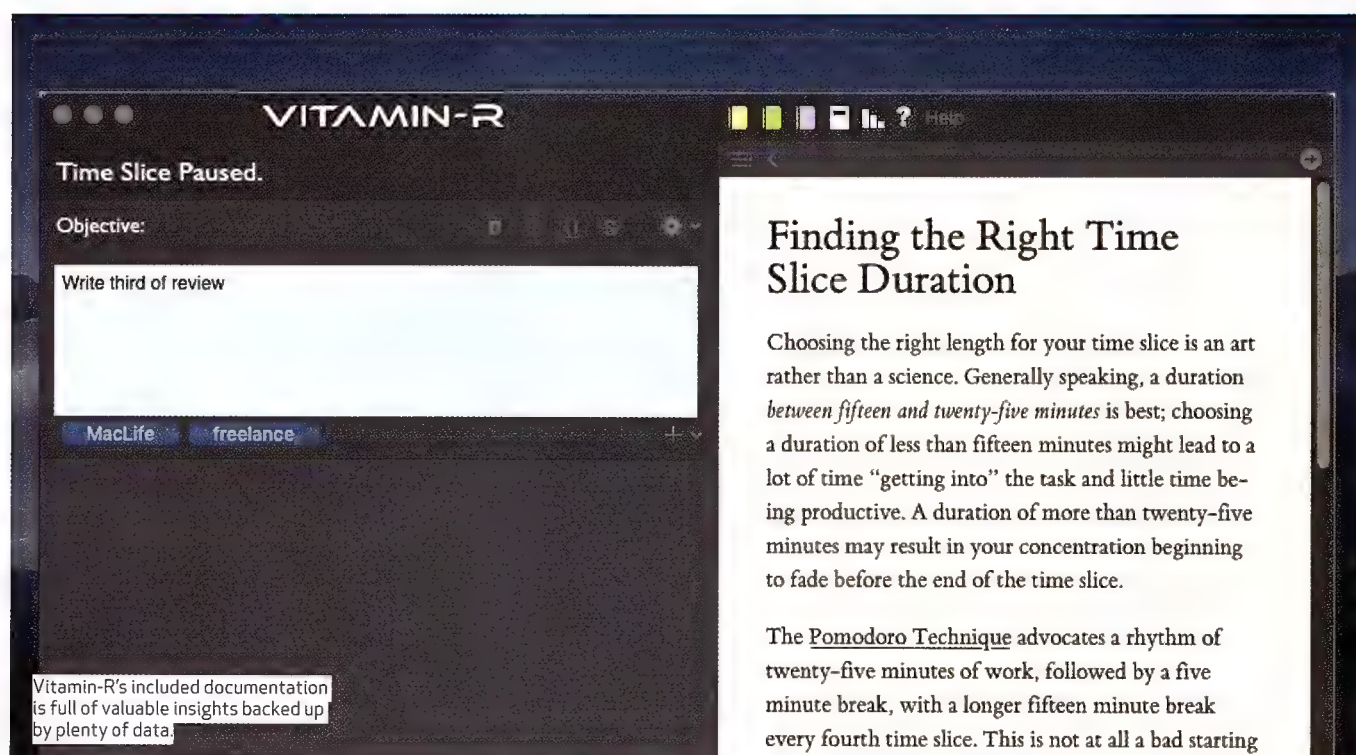
Most threats are immediately scrubbed without ever hitting the quarantine folder, but even quarantined malware is securely and permanently deleted. There are a few extra steps needed to install and set up Bitdefender. You're walked through each step, but it may still be slightly confusing for those who want something a little more plug-n-play.

Bitdefender is a good deal if you need to secure a computer on a budget. It's only \$70 for the first year and covers up to three devices. **Nicole Johnston**





Mac » APPS

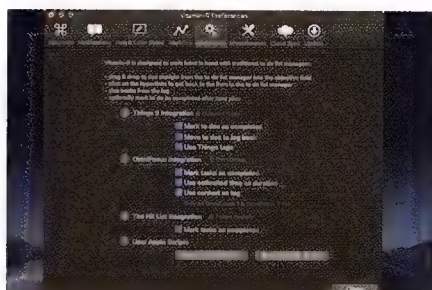


Vitamin-R 3

Your personal productivity sidekick for Mac.

US\$24.99 | PUBLICSPACE.NET | NEEDS OS X 10.11 OR LATER

Readers who are familiar with the Pomodoro Technique are halfway to understanding what Vitamin-R is all about. The time management method developed by Francesco Cirillo in the late 80s aims to break down work into manageable chunks. The general idea is to decide on a specific achievable objective, work for 25 minutes, and then take a short break when the timer rings,



The app includes optional deep integration with task managers like Things and OmniFocus.

before resuming the task for another 25 minutes. Working in short time slices like this aims to make it easier to stay motivated and focused, and many swear by the method.

Vitamin-R is a means to implement the technique on your Mac desktop, but it's also so much more, as it integrates several tools that accompany you along the path towards achieving your goals. The app lives in your menu bar, and clicking its icon brings up the main window, which is divided in two: the Workflow View and the Pad View. In the Workflow View you're invited to state your objective for the time slice. Below this lies a slider where you can choose a duration for the current time slice and watch as the allotted time slowly elapses.

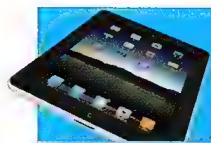
TAKE A BREAK

Meanwhile, the Pad View can display a Now pad to structure thoughts, a

Later pad for things that can wait, and a Scratch pad for rough ideas. There's also a Log Book that the app pre-fills with customisable stats as an insightful record of your performance.

There are plenty of useful new features in Vitamin-R – Soft Break lets you delay a break to finish off what you were doing, while the Now Pad includes a Fast Type mode that lets you create bullet points and action items as quickly as possible. Other neat touches include the option to play a background noise to help get you into your flow, as well as key shortcuts that let you quickly switch to the app window and navigate it without taking your hands off the keyboard. We particularly like the option to lock your Mac's screen in order to force you to take a break.

Vitamin-R is one of the most comprehensive time-boxing solutions for overcoming procrastination we've seen. **Tim Hardwick**



App Store » iOS APPS

An Environmentalism for Information 235

The attack on Net neutrality, by contrast, is an attempt by the companies who own the networks to be allowed to discriminate between favored and disfavored content, giving the former preferential access. (One wit analogized it to letting the phone company say, "we will delay your call to Pizza Hut for sixty seconds, but if you want to be put through to our featured pizza provider immediately, hit nine now!") **Taken together, these proposals would put the control of the computer back in the hands of the user, the content and the operating system, and control of the network users' choices in the hands of the person who sells them their bandwidth.** At the same time, our intellectual property agenda is filled with proposals to create new intellectual property rights or extend old ones. That is the openness aversion in action.

Now, perhaps to you, the closed alternatives still sound better. Perhaps you do not care as much about the kind of technological dynamism, or anonymous speech, or cultural ferment that thrills the digerati. Perhaps you care more about the risks posed by the underlying freedom. That is a perfectly reasonable point of view. After all, openness does present real dangers; the same freedom given to the innovator, the artist, and the dissident is given to the predator and the criminal. At each moment in history when we have opened

GoodReader 5

One of the best iOS PDF apps.

\$9.99 | GOODREADER.COM | NEEDS IOS 9 OR LATER

GoodReader is one of the most popular PDF apps for iOS. The latest upgrade brings an overhauled interface, better security and improved performance.

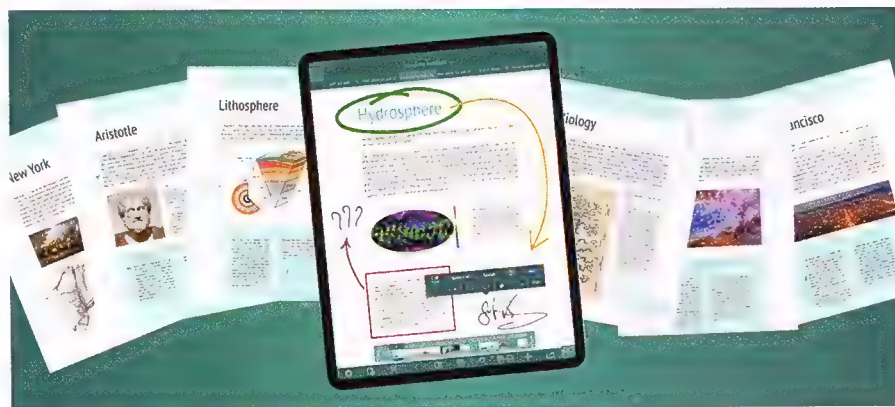
The core app is \$9.99, plus \$9.99 for the Pro pack. This adds split-screen PDF viewing on iPad, secure email/export of PDFs and extracts and a feature called Secure Photocopy, which removes all traces of hidden or redacted information in a PDF, making it safer for distribution.

Both versions let you crop, annotate and rearrange pages, and the PDF Reflow feature works like Safari's reading mode, pulling out text for easier

reading. When you're in this mode, you can copy the entire page's text to the clipboard. The app supports PDF, docx, HTML and text files. It can handle embedded audio and video in these files too, with a redesigned video player and graphics viewer.

The app now supports Apple Pencil, so you can annotate, highlight or scribble, and there are simple drawing tools. Note though that it doesn't currently ignore finger input.

GoodReader has always been a great way to annotate, convert, share or sign PDFs, and the latest version is faster and more useful. **Carrie Marshall**



Loose Style



L3 L4 L5 L6 L7

Go through the styles, then tweak the one that works best.



Inkwork

Can't draw? Algorithms can.

\$4.49 | CODEORGANA.COM/INKWORK | NEEDS IOS 9 OR LATER

This iOS app should appeal to fans of drawing apps like Prisma. Inkwork specialises in black-and-white sketches, though you can use any two colours for the 'canvas' and 'ink'.

Load up a photo and Inkwork quickly renders it, picking out salient details with lines that curl and taper as if drawn by hand. You can tap the pen icon and flick through nearly 100 styles, organised in categories like Cartoon, Bold, Graphic, Wash and Hatch. We found that nearly all the options produced clear results; to help, an icon at the foot of the screen lets you adjust detail level. A neat interface makes it fun to play around.

The results are bitmap, not vector, and the resolution of the exported file matches the original photo. This is sensible, but for printing at large sizes you might want to scale up the original photo in an image editor before you start, rather than trying to scale up Inkwork's output. It would be nice to have an option for this built in, along with the ability to adjust contrast and gamma.

You can order posters, canvases, and framed prints from CanvasPop within the app, but you're not nagged to do so. **Adam Banks**



Google Play » ANDROID

Spotify Stations

Tune in.

FREE (PREMIUM \$11.99 A MONTH) | SPOTIFY.COM



Spotify Stations is a supplement to the main Spotify app, and is sort of like an iPod Shuffle to the regular app's iPod. It's a minimalist take on Spotify, with music sorted by stations, so that you can't just listen to a full album or crank through the entire back catalogue of Fleetwood Mac in order. You pick 'stations', which are named after genres, eras and artists, and then enjoy a curated feed of music. If you pick an artist you can choose to just shuffle through their catalogue or play music that is like theirs as well, which is, theoretically, a cool way to find new artists. It's not as effective, though, as the full suite offered in regular Spotify – Stations is meant to complement, not replace it. It's going to fill a gap in certain people's lives, making it easy to immediately start listening to, say, 90s hip-hop, or music that sounds like Arcade Fire. Just know that you'll need to switch back when the mood to roll through Queens' Greatest Hits Vol 1 again inevitably hits.



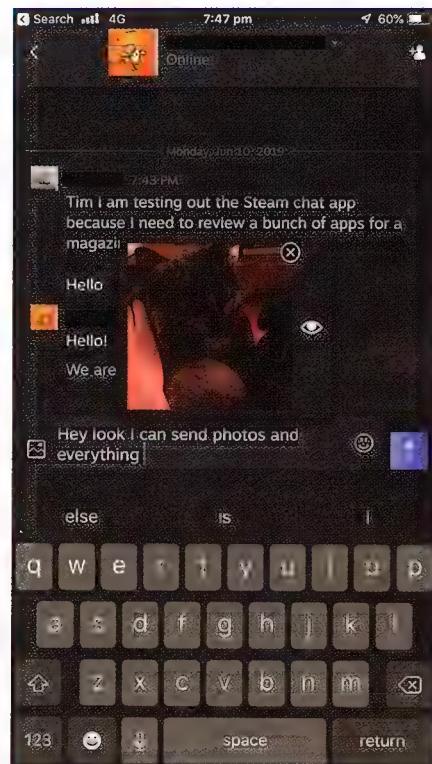
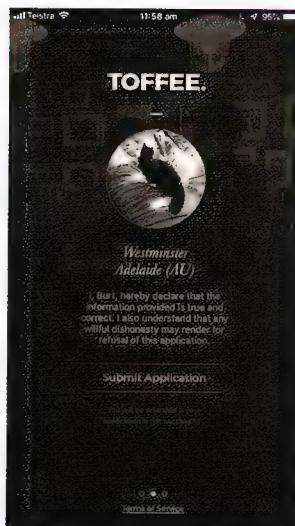
Toffee

Tough to chew.

FREE (MEMBERSHIP REQUIRED EVENTUALLY) | HTTP://TOFFEE.DATING



As someone who went to a private school, who is now quite poor and yet is still theoretically eligible to use this dating app, which only lets you join once you've nominated which private school you went to (although as far as I can tell it's very easy to lie about this without repercussion as it does not request proof), I'd like to say, in the plainest terms, that Toffee is extremely bad. With app-based dating continually growing, there's perhaps some comfort in the idea of an app that tries to be a bit more selective in how it guides you – but not like this. During registration it asks if you're male or female – no options beyond this – and it never asked me for my sexual preferences or anything like that. The app is focused on tailoring very specific dates, too, rather than just letting you get to know a lot of people and see if sparks fly. It's a classist disaster. Stick with Bumble and Tinder.



Steam Chat

When the chat gets steamy.

FREE | STORE.STEAMPOWERED.COM



One of the weird elements of modern friendship is that your ways of communication become fractured between phone calls, text, Facebook Messenger, Twitter DMs, Slack, Whatsapp, and those folks you only ever see in person.

One friend exclusively contacts me through Words with Friends DMs, and I have him in mind as I check out Steam Chat, a mobile app that lets you chat with your Steam pals wherever you are.

It all works, although the UI is a bit ugly, and in a message I found that I had to exit back out and return to clear the keyboard sometimes, which is a little cumbersome. It also seems to carry no record of previous conversations you've had in the computer client.

Basically, Steam Chat does what you would expect it to – it lets you take Steam Chat with you wherever you go, and spy on what your friends are playing. Theoretically it should make it easier to send photos from your phone too, but I found that anything I sent failed to open in the Steam client. There are no bells or whistles, but that's fine. ■ James O'Connor



Solus 4.0

A user-friendly rolling release distro written from scratch sounds more like marketing hype than a usable product – or so Mayank Sharma thought.

FREE | [HTTPS://GETSOL.US](https://getsol.us)

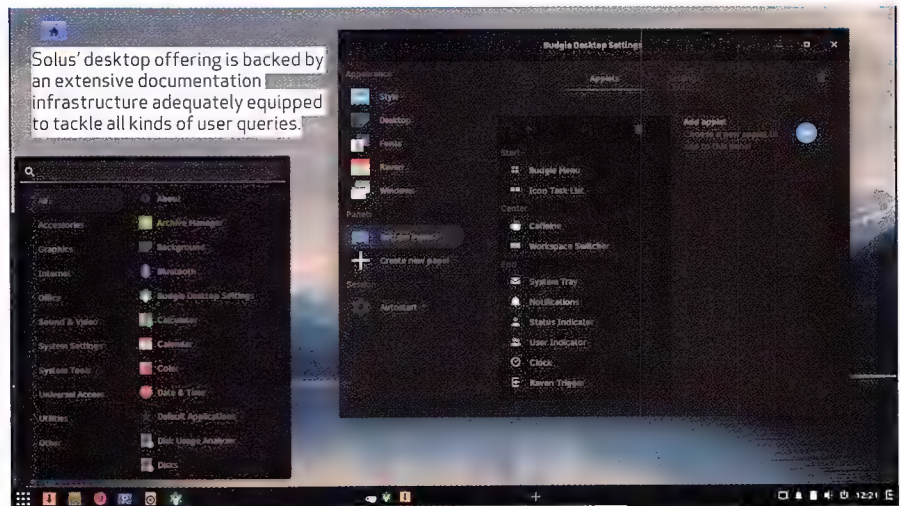
Unlike mainstream desktop distros that have release cycles set in stone, small ones like Solus kind of just wing it – they ship when they are ready. Solus 4 has been simmering for over a year now and this final release delivers a solid and stable desktop that's a change from the mainstream.

Solus 4 is available for 64-bit machines only but in three editions, each based around a different desktop environment. Besides the marquee Budgie-based edition, there's one with Gnome and another with MATE. All editions ship with the usual bouquet of apps you'd typically use on a desktop. The distro uses its own installer, which is easy enough to navigate irrespective of the user's experience. It does, however, have its peculiarities. For instance, it offers an option to encrypt the installation partitions, but only when you choose to create LVM partitions. There's also no fancy slideshow to showcase the features of the distro while it's busy copying the files to the hard disk.

The marquee feature of the distro is its Budgie desktop. It's written from scratch using components from the Gnome stack. Its most noticeable feature is the unified notification and control centre sidebar called Raven, which also gives you quick access to the calendar and media player controls. The volume control in Raven now offers separate controls for controlling input and output sounds. You can also set different volume levels for individual apps straight from the sidebar.

BUDGIE UP

Budgie is easily customisable and offers enough options to help you mould it as you want. For example, by default Budgie doesn't show icons on the desktop and has only one workspace, but both of these behaviours can be overridden easily from the Budgie Desktop Settings app. Several of the sections here have new



"Budgie is easily customisable and offers enough options to help you mould it as you want."

options, and there's also an entirely new one for customising how the Raven notification centre works.

Our only complaint with Budgie Desktop Settings is that it now offers so many options that the developers should seriously consider coding in a search function to help users find their way to the relevant ones. For instance, you need to add the Workspace Switcher applet to the panel before you can switch workspaces, which isn't the most obvious place where a new user would look for this setting.

All the elements on the desktop are implemented as applets – including the application menu, which has been further refined in this release – along with the IconTasklist applet, which has new context menu options. There's also a new applet called Caffeine Mode which prevents power-saving settings from kicking in right when you don't want them to.

The other major highlight of the distro is the Software Center, built

around the eopkg package management system, itself a fork of the PiSi package manager that comes from Pardus Linux. The app is very user friendly and intuitive to operate, and besides Linux binaries also offers several third-party apps. It feels more responsive than other similar offerings from the Gnome and Ubuntu stables.

The project also has a sensible policy for software updates. The distro is a rolling release, as the installation will never reach end-of-life and will receive updates throughout the project's existence. But its developers push updates to the stable repository only after they've gone through some testing in the unstable channel. We also like the way updates are exposed in the Software Center; besides the mandatory updates that are selected automatically, you have the option to easily view and pick any other updates that you want to install. ■

Work around: Professional ultrabooks and 2-in-1s roundup

Are laptops finally at a point where you can ditch the work PC altogether and go totally portable? Joel Burgess puts the best portable ultrabooks and 2-in-1s through the labs to find the perfect device for any workflow.

As smartphones continue to become more important for our web searching and social media needs, the personal laptop is undoubtedly losing favour, but there's still nothing that can better accomplish the dynamic needs of the modern worker than a professional ultrabook or 2-in-1. Depending on your line of work, the tasks required by such a device will range from simple internet browsing to advanced graphical and video rendering.

The vast majority of laptops these days will be able to adequately run demanding applications like Photoshop, but having enough RAM and a GPU that can accelerate OpenCL tasks could give you the option of working entirely from your laptop.

Laptops with dedicated gaming-level graphics cards have come down in size enough over the last few years to fit into an ultrabook form factor. You'll have to be willing to sacrifice half a centimetre or so in thickness and a half a kilo for the additional hardware required, but there are a number of sub-2kg laptop offerings that'll deliver

comparable experiences to desktop PCs with entry level gaming or workstation GPUs.

Whether you're looking to enhance your work/life balance or ditch the need for a traditional tethered PC altogether, there are multiple units in the roundup that range to six-core, 9th-generation Intel Core i7 CPUs or offer Nvidia GeForce RTX 2070 GPUs for supercharged professional laptop performance.

On the other hand if you're looking for something that's as compact as possible and offers a little more versatility for viewing emails, web

browsing and document processing, then a 2-in-1 might still be the best option for you. If you're happy to pay for it, Dell's XPS 15 2-in-1 or Microsoft's Surface Book 2 (page 41) come with GPUs that are capable of light gaming and reasonable graphical workloads. If not there's plenty of less expensive options that offer much better performance over cost ratios for the more frugal business men and women.

As such, this year's professional laptop roundup includes a diverse range of offerings catering to a wide variety of needs and budgets.

How we tested

Each device was benchmarked using APC's rigorous benchmarking regime, which gives deep and independent insights into the unit's peak performance on both a granular processing level and for general everyday computing tasks. The detailed CPU, GPU and battery benchmark results can be found on pages 48 & 49 and let you see for yourself exactly how well each device performs. This is combined with a broad knowledge of available laptops to offer insights on the overall value of specific configurations.

ULTRABOOKS



\$3,499 | WWW.APPLE.COM/AU/

Apple MacBook Pro 15

Is this still the benchmark for the perfect professional ultrabook?

It's hard to not be impressed by the aesthetic of the MacBook Pro. The honed aluminium unibody looks great in space grey or silver, the tenkeyless keyboard is neatly centered by two perforated grills containing a high dynamic range stereo system, and the super-sized trackpad offers as much silky smooth cursor control as anyone could want.

Apple was keen to talk about its Core i9 variation of the 2019 MacBook Pro in briefings, but we got our hands on the more affordable \$3,499 model, with a Core i7-9750H CPU. This unit comes with 16GB of RAM and a 256GB PCIe SSD, but can also be configured with 32GB of RAM and up to 4TB of PCIe SSD storage. One of the benefits of the 15-inch MacBook Pros over their 13-inch counterparts, apart from getting a larger 2880 x 1800 pixel (16:10) retina display, is that they feature a dedicated AMD Radeon

Pro 555X or 560X GPU. While we wouldn't go so far as to say this was a full gaming GPU since it only manages 26.3fps in the *Total War: Warhammer 2* battle benchmarks using Low 1080p settings, it is around twice as powerful as the integrated Intel UHD Graphics 630. This makes it useful for anyone looking for a little extra graphical processing power at work and is a step up for light gaming.

The MacBook Pro 15 also offers a generous 84Wh battery which managed to last an impressive 10 hours and 17 minutes during continuous 1080p movie playback.

Verdict

Still one of the best professional laptops you can purchase... if you're happy to pay a premium.



\$1,249 | WWW.ASUS.COM/AU/

Asus Zenbook 14 UX431FA

Catering to a diverse set of needs or just bamboozling buyers?

A few years ago Asus's ZenBook range were really pushing the ultrabooks spec, but today it really looks like Asus are more concerned with creating the largest number of Zenbook variations possible.

The ZenBook 14 is currently sold as either a UX431, which comes in Utopia Blue (silver) and has a 47Wh battery, or a UX433 that comes in Royal Blue or Icicle Silver and weighs roughly 300g less, has smaller speakers and features a three-cell 50Wh battery. There's an additional suffix on both of these variations that denotes whether it has an Intel UHD Graphics 620 GPU (FA) or an Nvidia GeForce MX150 GPU (FN), but if that wasn't enough, there also seems to be a number of minor model variations that differ depending on the outlet it is sold in. The model we tested was a 14-inch Asus ZenBook 14 UX431FA-AM018R with a fingerprint

reader, a Core i5-8265U CPU, 8GB of RAM and a 256GB PCIe SSD. This device is aiming for the entry level professional laptop market and while we don't love the brushed metal veneer or the thick plastic screen bezel, the price is pretty competitive considering the 1.6cm thickness and the overall 1.36kg weight.

The Core i5-8265U CPU performed well, beating the Acer Spin 5 by up to 13% in a number of raw CPU processing benchmarks and showed a 40% bump in PCMark 10 scores.

The 4.5h 1080p movie playback battery lifespan is pretty standard on cheaper ultraportables and the keyboard and trackpad are nice to use for an ultraportable.

Verdict

The Zenbook 14 UX431FA-AM018R is a well priced entry level professional ultrabook.





(i7, 16GB, 1TB) \$3,239 | WWW.DELL.COM

Dell XPS 13 (9380)

Is Dell's XPS 13 falling behind the competition?

Dell's XPS 13 has been at the top of our best value ultrabook list for the past few years, but this winning formula hasn't changed much during that time. The new XPS 13 (9380) does have a couple of minor updates like the camera placement and the Frost White limited edition, but newcomers like Huawei and the Razer Blade Stealth are doing much more by driving down price expectations.

The XPS 13 comes with either an Intel Core i5-8265U or a Core i7-8565U CPU, 8 or 16GB of RAM, and one of the three sizes of PCIe connected SSD storage (256GB, 512GB and 1TB). These units range in price from the one Core i5 model at \$2,299 to \$3,599 for the top of the line Core i7 model that has a 16GB RAM and a 1TB NVMe SSD.

The unit we tested came with a Core i7-8565U CPU that offers a 1.2GHz bump in maximum clock speed from last year's i7-8550U. This

didn't make a massive difference to the devices' PCmark 8 scores, however raw processing tasks showed between a 5 and 15% bump and PCMark 10 tests showed a 26.1% boost for general work tasks. Unfortunately we were able to get all cores on the CPU to readily spike to 100°C, which isn't great for longevity.

The Intel UHD Graphics 620 GPU returns on the 2019 XPS 13, getting just 30% of anything running a Nvidia GeForce MX150 in graphics benchmarks. The 52Wh lithium ion battery is also the same capacity, but this time it's running a 4K screen, which shortened the movie playback lifespan by 37% to a total runtime of four hours and 31 minutes.

Verdict

The GPU and battery aren't the best, but it does offer bigger SSDs and higher screen resolutions.



FROM \$2,779 | WWW2.RAZER.COM/EN-AU/

Razer Blade Stealth 13 (2019)

Now with a new CPU/GPU combo.

While Razer is generally considered a gaming company the Blade Stealth range has always been tailored to a professional market since it ditched the dedicated GPU for a compact ultrabook profile. That said, the units have always featured Thunderbolt connections that can be attached to Razer's GPU accelerator and the latest model gets its own discrete GPU for a serious uptick in home office graphics. This year's Blade Stealth has an updated Intel Core i7-8556U CPU and the Advanced model comes with 16GB of RAM, a 256GB PCIe M.2 SSD and a Nvidia GeForce GTX MX150 GPU.

While the new CPU offers up to 50% boosts on 1080p media encoding and other CPU heavy tasks over its predecessor, the discrete GPU is three times more powerful than Intel's 620 Graphics. At roughly 50% lower performance than a

GTX 1050, you wouldn't call it a proper gaming GPU, but it will mean you can play titles like Ghost Recon: Wildlands at 30+ fps with low settings at HD resolution.

This year's Stealth replaces the neon Razer green logo with a more office-appropriate black on black insignia. Sliding in at a 1.48cm thick, the new Stealth earns its Razer name and the 30.5 x 21cm footprint and 1.28kg weight make this device about as portable as a laptop can be.

Despite being so compact there's a nicely weighted keyboard that has a decent travel distance and the 53Wh Li-Ion battery will last about four hours and 20 minutes in performance mode.

Verdict

A little short on storage, but offers an appealing aesthetic and a minor graphics bump.



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2-IN-1s



\$1,498 | WWW.ACER.COM

Acer Spin 5

Does this 2-in-1 spin the premium professional laptop market right round?

The Acer Spin 5 misses out on a 4K screen, opts for a smaller, slower 256GB or 512GB SATA SSD and it doesn't splurge on the excessive 16GB RAM allocation seen on many professional 2-in-1 competitors. This might seem like a disadvantage, but in many ways the Spin 5's concessions make it a much better value device.

The 13.3-inch FullHD screen doesn't have quite the same vibrancy as some of the 4K convertibles we've seen and it's framed by relatively large black bezels, but on a screen this size the distinction isn't as great as you might think. The lower resolution cuts down on energy consumption, meaning the smaller 52.4 Wh battery can last four hours and 15 minutes during movie playback. Combine this with an excellently optimised quad-core i5-8250U that operates between 1.6 and 3.4GHz to maximise performance and minimise

idle power consumption, 8GB of DDR4 RAM, and you get one of the best power consumption-to-performance ratios we've seen in a 2-in-1. This chip allows the Acer Spin 5 to perform on par with the 8th-gen i7 CPUs you see in devices like the Lenovo Yoga 920 on a range of home, work and general CPU compute tasks. While the trackpad and the keyboard aren't the nicest we've tested in the roundup, they still feel really good and there are a few perks like an SDcard slot and a fingerprint sensor thrown in to sweeten the deal. We've seen this high achiever going for as little as \$1,300, which makes the Spin 5 the best value laptop in the roundup.

Verdict

If you're willing to give a little on looks, performance and battery life you can save a lot with the Spin 5.



\$2,999 | WWW8.HP.COM/AU/

HP Spectre Folio

Has HP minced its latest, or is everyone going to lap up this leatherbound laptop?

The Spectre Folio was one of the first devices we tested with an eighth-gen Y-series CPU, which were announced back in August of 2018. The hyper-efficient dual-core Core i7-8500Y CPU in the Spectre Folio is passively cooled.

The vast majority of today's premium 2-in-1s use U processors, which have transitioned to four cores over the last year, so pretty much any other 2018 convertible will offer roughly double the raw compute power of the Spectre Folio. This device does punch above its weight in general home and work tasks by boosting to a speedy 4.1GHz over short periods, but it scores 45% less than a Lenovo Yoga 920 with a quad core i7-8550U CPU in Geekbench multi-core CPU tests.

This chip also takes a hit in the graphics department with the Intel UHD Graphics 615 scoring between 45 and 60% lower on 3DMark's

Time Spy when compared against similar 2-in-1s with Intel HD 620 GPUs.

The 13.3-inch touchscreen is dull – we expect this has something to do with the screen's thermal constraints when wearing leather – but it's also only FullHD, which is unusual for any convertible that costs this much. The ultra efficient CPU and dull screen combine to give a particularly long battery life when watching movies (HP claims up to 19 hours with a conservative screen brightness), but put it under any load (say PCMark 8's Home accelerated battery benchmark) and battery life drops back to five hours and 12 minutes.

Verdict

Takes a hiding on power, performance and price, but it is leather bound...





\$2,999 | WWW3.LENOVO.COM/AU/EN/

Lenovo Yoga 920

Bends over backwards to be the most premium 2-in-1 available.

If you're going to settle on just one device for all your tablet and laptop needs, then it really should be something that has enough premium features to enhance the experience across both formats.

Whether it is the 8th generation Intel CPU, the generous 16GB RAM or the vivid 4K screen, there's no doubting that the flexible Yoga 920 from Lenovo packs some premium parts. The 13.9-inch UHD IPS touchscreen sees the return of 5mm vertical bezels that allow it to occupy almost the entire top half of the unit. This vibrant screen is tied to a premium keyboard and powdery trackpad by the company's signature watchband hinge, which gives excellent stabilisation and balance to the screen, while maintaining the flexibility to flip a full 180 degrees. Not only do the keys offer nice resistance for an excellent typing experience on such a thin base, but the lightweight

bottom half also manages to pack in a 512GB NVMe SSD and a large 70Wh Li-Polymer battery. These generous parts offer a lot of exceptionally fast storage and 8.5 hours of battery life for video playback, but are also engineered to add the perfect balance of weight to keep the unit stable.

Despite having an Intel Core i7 CPU and a generous RAM allocation the Yoga 920 isn't the highest performing device across the board. In PCMark 10 the Yoga 920 was between 15 and 40% off the top performers here and while the stock Intel UHD Graphics 620 will be suitable for most work tasks, any kind of rendering or graphical work will be beyond it.

Verdict

One of the few premium 2-in-1s that is great as both a laptop and a tablet.



\$3,498 | WWW.MICROSOFT.COM/EN-AU

Microsoft Surface Book 2 (13-inch)

Continues a legacy of success.

At a glance, the Surface Book 2 is nigh-indistinguishable from its predecessor – both 2-in-1s offer a main detachable 13.5-inch (3,000 x 2,000-pixel) tablet alongside a matching keyboard base, which smartly houses a second battery and (optionally) graphics processor, with the latter ostensibly included to help beef-up the machine's multimedia-editing chops.

The Nvidia GeForce GTX 1050 GPU in the base means the Surface Book 2's good for a bit of gaming, but what that chip's really intended for is GPU-accelerated media rendering and encoding and, frankly, there are better laptops out there if you're after one primarily for games. That chip combined with the Core i7-8650U CPU in our review unit did help ramp up encoding speeds, giving you about twice the power of what's in say, the Acer Switch 5. And to get

anything beefier, you'll generally need to go for a significantly thicker (and, at full tilt, louder) laptop thanks to the greater cooling requirements.

The Book 2's battery life is also admirable, ranging from seven to 10 hours in our tests – something that's helped along by that second battery underneath the keyboard. Without that, the runtime is cut in half – which is still not bad for a large-screen tablet.

The entry-level Core i5/256GB model costs a fairly reasonable \$2,199 – although it doesn't include that Nvidia GPU – with three further models on offer, topping out at the \$4,499 Core i7/1TB model.

Verdict

An iterative update to Microsoft's best 2-in-1 brings faster hardware to the same classy overall design.



DISCRETE GPU's



\$2,999 | WWW.GIGABYTE.COM/AU

Gigabyte Aero 15-X9

Immense gaming abilities at the expense of size and battery life.

The Aero 15 is one of the few true gaming laptops that is compact enough for us to genuinely consider it as a good professional ultraportable option. Wrapped in a neat matte black chassis the 2019 Aero 15 was one of the first local devices to get an Nvidia RTX GPU into a device with a 1.9cm profile.

The Aero 15 comes in a range of variations but the X9, featured here, came with an Nvidia RTX 2070, 16GB of RAM and a 1TB PCIe SSD. While it can be configured with either an Intel Core i7-8750H or a Core i9-8950HK CPU, the X9 is only available as a Core i7 locally. You can also choose between a 15.6-inch FHD 144Hz IPS display or a 15.6-inch UHD 60Hz IPS display, depending on whether you prefer resolution or responsiveness in your games.

The Core i7-8750H CPU on the two gaming laptops in the roundup offers six cores and 12 threads, two more

than the 4/8 configurations that are generally given to ultrabooks. This means the Aero 15 offers a massive boost over the competition, netting the highest PCMark 10 score of the roundup by 23%. The Aero also had the best graphical performance of the roundup, performing between 18 and 40% better than MSI's P658RE.

The Aero 15-X9 we tested netted only four hours and 57 minutes in 1080p movie playback using the native 4K resolution at 50% brightness, a lot less than some of the competition listed here, despite the generous 94.2Wh battery.

Verdict

The Aero 15 sets an extremely high benchmark in the professional ultraportable space.



FROM \$2,899 | WWW.MSI.COM

MSI P65 8RE

MSI's Prestige ultrabook is basically a GS65 in a silver suit, but is this professional powerhouse perfect?

If you loved MSI's 2018 GS65, but don't quite think you could get away with its gold grills in the office then you'll be jonesing for MSI's Prestige series P658RE. It's clear from the vent design and identical physical specifications that MSI has used the chassis of the GS65 to build the new P65.

The MSI P65 has an Intel Core i7-8750H CPU, 16GB of RAM and comes in two variations locally. There's either the silver P65 Creator 8RE, with a GTX 1060 (Max-Q), 60Hz FHD IPS display and a ludicrously small 256GB PCIe SSD. Alternatively, there's a much more sensible limited-edition white P65 8RE, fitted with a GTX 1070 (Max-Q), a 144Hz FHD IPS display and a far more reasonable 512GB PCIe SSD. The latter of these devices we would recommend, the other... probably not. The overall performance was within 5% of what we got for MSI's GS65 Stealth

Thin gaming ultrabook in raw CPU benchmarks, which is unsurprising considering they share nearly identical components. We tested the silver P65 8RE with a GTX 1060 (Max-Q) GPU, which makes it a proper gaming laptop that'll be suitable for heavy mobile GPU workloads and games at high to ultra 1080p graphical settings.

The P65 8RE's offers PCIe SSD read speeds of 934 MB/s and write speeds of 2913 MB/s which is common in this bracket, and is two to three times faster than SATA connected SSDs. The P65 lasted three hours and 53 minutes in the PCMark Home battery benchmark thanks to a generous 80Wh battery, which means it lasts as long as many of the professional offerings here.

Verdict

Slightly thicker than an ultrabook, this is a powerful workhorse that can also game.



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5 WATCHES TO DIE FOR
2019's most desirable new timepieces

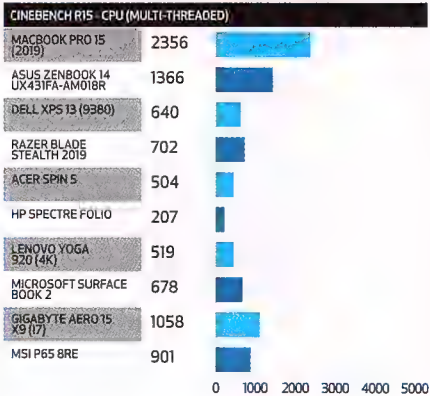
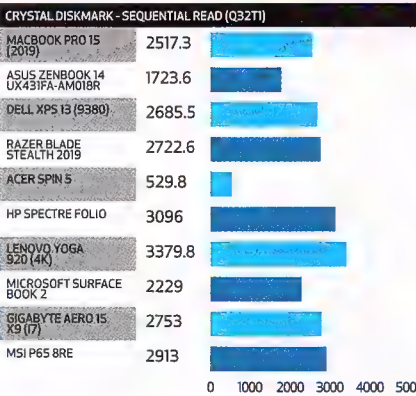
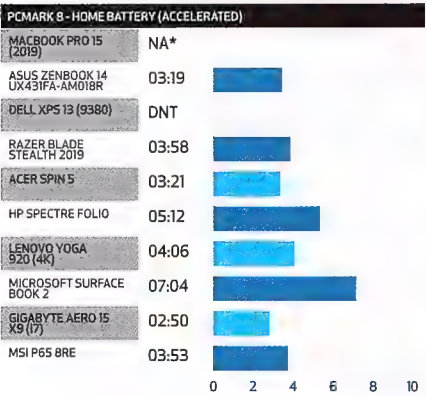
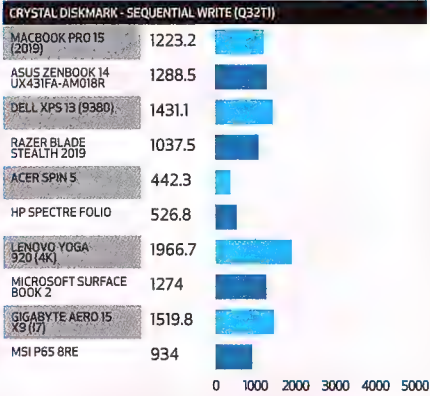
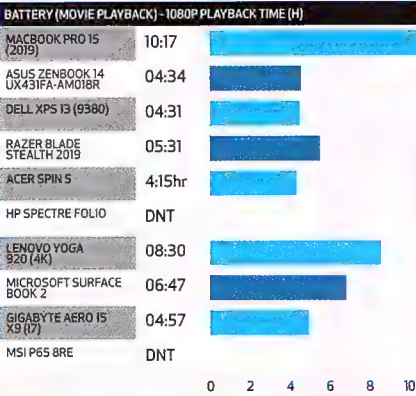
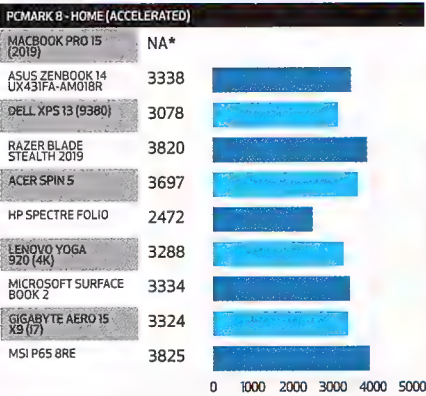
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THE BEST TECH FOR EVERYTHING.
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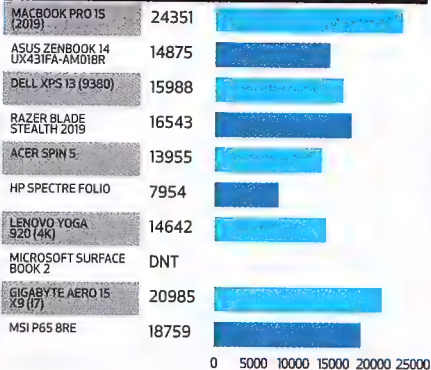
LABS BENCHMARK RESULTS



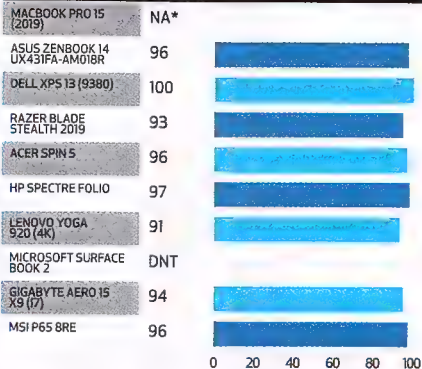
PREMIUM LAPTOP SPECIFICATIONS

	MACBOOK PRO 15 (2019)	ASUS ZENBOOK 14 UX431FA-AM018R	DELL XPS 13 (9380)	RAZER BLADE STEALTH 2019	ACER SPIN 5
STREET PRICE	\$3,499	\$1,200	\$3,499	\$2,499	\$1,300
SCORE	4.5	3.5	4	4.5	4
CPU	INTEL CORE I7-9750H	INTEL CORE I5-8265U	INTEL CORE I7-8565U	INTEL CORE I7-8565U	INTEL CORE I5-8250U
MEMORY	16GB	8GB	16GB	16GB	8GB
GPU	AMD RADEON PRO 555X (4GB)	INTEL UHD 620	INTEL UHD GRAPHICS 620	NVIDIA GEFORCE MX150	INTEL HD GRAPHICS 620
STORAGE 1	256GB PCIE SSD	256GB WD PCIE SSD	1TB SK HYNX PCIE NVME SSD	256GB M.2 NVME SSD	256GB MICRON SATA SSD
STORAGE 2	NONE	NONE	NONE	NONE	NONE
SCREEN SIZE	15.4-INCH	14-INCH	13.3-INCH	13.3-INCH	13.3-INCH
SCREEN TYPE	IPS	IPS	TOUCH	IPS	IPS
RESOLUTION	2880 X 1800 (16:10)	1920 X 1080 (16:9)	3840 X 2160 (16:9)	1920 X 1080 (16:9)	1920 X 1080 (16:9)
SCREEN FINISH	GLOSS	MATTE	GLOSS	MATTE	GLOSS
BATTERY CAPACITY	84WH	47.1WH	51.9WH	53WH	52.4WH
DIMENSIONS (MM)	349.3 X 240.7 X 15.5	323 X 211 X 15.9	302 X 199 X 11.6	304.6 X 210 X 14.8	381.5 X 258.1 X 17.9
THICKNESS (CM)	1.6CM	1.6CM	1.2CM	1.5CM	1.79CM
WEIGHT	1.83KG	1.36KG	1.22KG	1.27KG	1.6KG

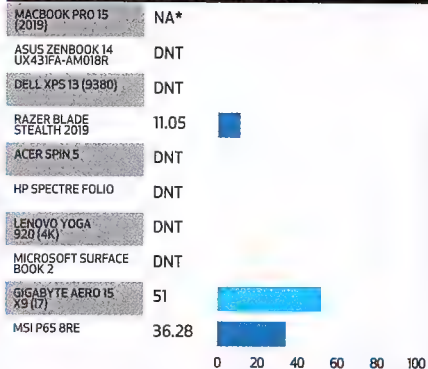
GEEKBENCH 4 - CPU (MULTI CORE)



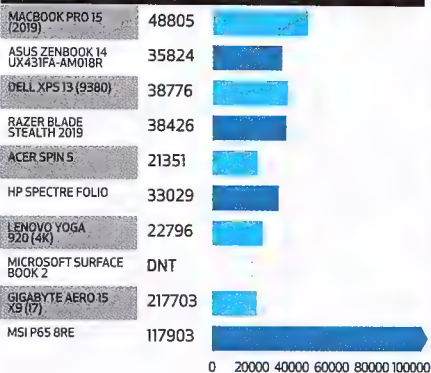
TEMP. PEAK CPU TEMPERATURE (°C)



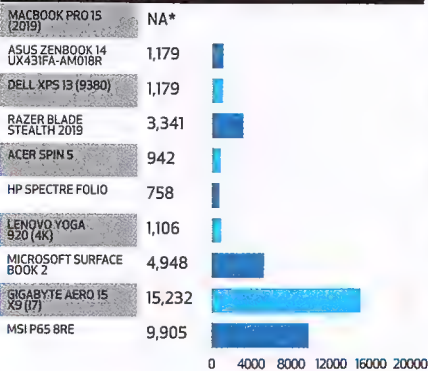
GHOST RECON WILDLANDS - 1080P, ULTRA (AVG FPS)



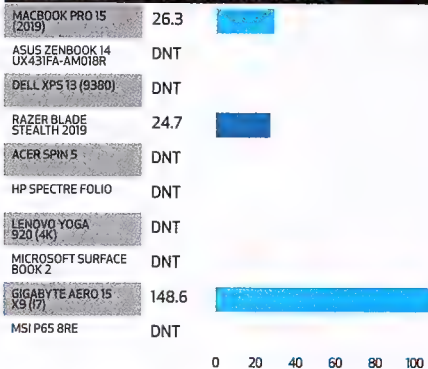
GEEKBENCH 4 - GPU (COMPUTE)



3DMARK (2013) - FIRE STRIKE

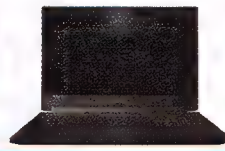
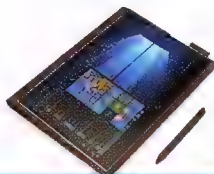


TOTAL WAR: WARHAMMER 2 (BATTLE) - 1080, LOW (AVG FPS)



NA: TEST NOT APPLICABLE.
OS OR GPU NOT COMPATIBLE
WITH BENCHMARK.

DNT: UNIT NOT TESTED ON
THIS PARAMETER.



HP SPECTRE FOLIO

LENOVO YOGA 920 (4K)

MICROSOFT SURFACE
BOOK 2

GIGABYTE AERO 15 X9 (I7)

MSI P65 8RE

STREET PRICE

\$2,999

\$2,999

\$3,498

\$3,399

\$2,799

SCORE

3

4.5

4

4

3.5

CPU

INTEL CORE I7-8500Y

INTEL CORE I7-8550U

INTEL CORE I7-8650U

CORE I7-8750H

INTEL CORE I7-8750H

MEMORY

16GB

16GB

16GB

16GB

16GB

GPU

INTEL UHDGRAPHICS 615

INTEL HD GRAPHICS 620

NVIDIA GEFORCE GTX 1050
MZFLW10HMLH-000MU2070 (MAX-Q) NVIDIA
GEFORCE RTXNVIDIA GEFORCE GTX 1060
(MAXQ)

STORAGE 1

512GB TOSHIBA NVME SSD

512GB SAMSUNG NVME
PCIE SSD1TB SAMSUNG NVME
MZFLW10HMLH-000MU

1TB INTEL NVME PCIE SSD

256GB M.2 PCIE SSD

STORAGE 2

NONE

NONE

NONE

NONE

NONE

SCREEN SIZE

13.3-INCH

13.9-INCH

13.5-INCH

15.6-INCH

15.6-INCH

SCREEN TYPE

TOUCH

TOUCH

TOUCH (LCD)

144HZ IPS OR UHD

IPS

RESOLUTION

1920 X 1080 (16:9)

3840 X 2160 (16:9)

3,000 X 2,000 (3:2)

1920 X 1080 OR 3840 X 2160
(16:9)

1920 X 1080 (16:9)

SCREEN FINISH

GLOSS

GLOSS

GLOSS

GLOSS

GLOSS

BATTERY CAPACITY

54.28

70WH

75.3WH

94.2WH

80WH

DIMENSIONS (MM)

320.1 X 234.5 X 15.4

323 X 223.5 X 13.95

312 X 232 X 23

356.4 X 250 X 18.9

358.5(W) X 247.7(D) X
17.9(H) MM

THICKNESS (CM)

1.5CM

1.3CM

2.3CM

1.9CM

1.79CM

WEIGHT

1.47KG

1.37KG

1.91KG

2.11KG

1.88KG

BUILDER'S HANDBOOK

If you're reading this magazine, you probably know a thing or two about computers, or at least want to learn something. When it comes to building your own PC, there are numerous pitfalls to avoid and tricks to bear in mind. You need the right tools, the right knowledge, and the right level of emotional resilience to keep on trying when something inevitably goes wrong.

Building your own computer won't necessarily be cheaper and will definitely be harder than buying a complete system, but it affords you more control over the capabilities of your hardware. There are numerous issues to contend with when setting out to build a PC, even if you're a seasoned hardware guru, so with that in mind, here's some of the APC team's best advice.

01 PLAN YOUR BUILD

The first thing you should think about is what you actually want your build to do. Is it a beefy 4K gaming machine? A video-editing platform? A plain old work PC? Whatever the reason, it's important to nail down the build's purpose first. This will determine just about every aspect of the finished product, from your choice of processor to what OS you're going to install. Consider where the PC will sit – on your desk at work, or underneath your TV in your living room? If there are any key components you want to include – such as a specific case, or a GPU that is ideal for your chosen purpose – work that out sooner rather than later. Be sure to do a little research on alternatives, too.

02 ACQUIRE KNOWLEDGE

Do your research! There's a wealth of PC building information strewn across the internet, from tutorials to reviews – and there's also plenty of that in the magazine you're reading right now, too. Reviews are an extremely useful source of knowledge when it comes to choosing which parts you're going to use – flip to page 24 and you'll find some great ones. Manufacturers' websites are also worth a look; most have PDFs, manuals, and specification lists that can prove invaluable when it comes to actually building and setting up your new rig.



Whether you're new to PC building or a veteran, Christian Guyton discovers that we can all learn something new.





Component	Selection	Est.	Promo	Shipping	Tax
CPU	+ Choose A CPU				
CPU Cooler	+ Choose A CPU Cooler				
Motherboard	+ Choose A Motherboard				
Memory	+ Choose Memory				
Storage	+ Choose Storage				
Video Card	+ Choose A Video Card				
Case	+ Choose A Case				
Power Supply	+ Choose A Power Supply				
Optical Drive	+ Choose An Optical Drive				
Operating System	+ Choose An Operating System				

03 MAKE A PART LIST

Once you've got some ideas about what you want your finished build to look like, it's time to get organised and list the components you want to use. A trip to <http://au.pcpartpicker.com> (pictured above) will do you good here; not only can you easily tally up your budget and keep a running list of components you want to use, but the website flags up any compatibility issues that you might not otherwise notice. Consider your budget carefully at this stage – it's all too easy to drop too much on your GPU and not leave enough for a decent power supply. Unless you're in a major rush, it's usually worth waiting until components are on sale – you should be able to chop off a comfortable 10 or 20% from the final price with a little patience. And remember: RGB lighting might look nice, but you should always put performance first.

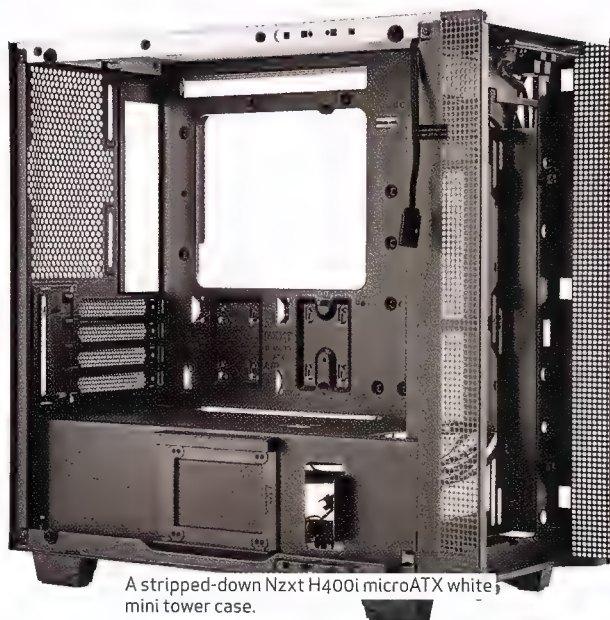
04 STRIP IT DOWN

We always recommend starting any build by stripping your case down to the bare essentials: Remove any side panels, dust shields, and windows. If you're not using the hard drive cages or additional brackets, remove them and don't put them back in; this helps to improve airflow by maximising negative space inside the case, and leaves more room for cable management. Be careful when removing any thumbscrews, particularly on glass panels. It's all too easy to leave an unappealing

smudged fingerprint on your otherwise unblemished case.

05 PART STORAGE

Don't throw away your boxes. The box your case came in, in particular, is useful both for storing panels during the build process and for holding the boxes of whatever components you're putting inside. If, like us, you're building PCs on a regular basis, this can be very helpful when it comes to keeping track of which component is in which case. In addition to good organisation, keeping the boxes comes in handy should you need to make use of a warranty and get a part replaced. Particularly when working with cases that have a lot of glass, storing window panels between the polystyrene that comes in the box can prevent them from being scratched or smashed.



A stripped-down Nzxt H400i microATX white mini tower case.



Same fan, different blades. The thick blades are optimised for high pressure, while the thinner blades maximise airflow.

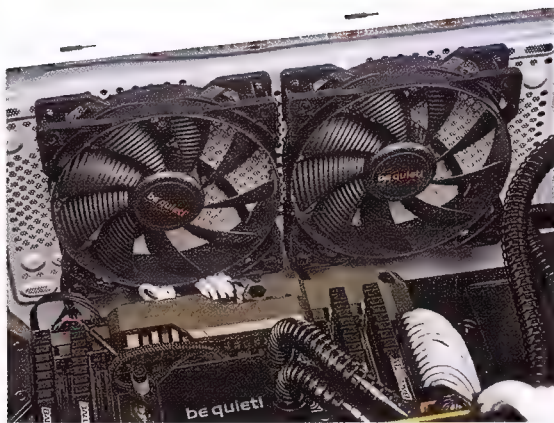
06 CHOICE OF FAN

To keep your case cool, the choice of fan is vital. In broad terms, fans fall into one of two categories: bulky static pressure fans, and thin many-bladed airflow fans. The former are designed for high-pressure environments, such as moving air through a thick heatsink, while the latter variety moves more air quickly through the case, but with reduced force. Mounting multiple airflow fans inside your case ensures – as their name implies – good airflow, but static pressure fans are vital for radiators if you're using an all-in-one cooler. Some fans utilise magnetic bearings to "levitate" the fan, which provides less noise and longer lifespans, but they typically come at a greater cost.

07 FAN MANAGEMENT

Most cases come with one or more fans pre-installed. These are typically stock fans from the case manufacturer or one of its partners; when it comes to keeping your build cool, they do the job, but generally don't measure up to fans purchased from dedicated manufacturers. Whether you're looking for high-performance cooling or silent running, there are often better options available. If you're upgrading the case fans,





A pair of Silent Wings fans is included as part of the package when you buy the Silent Loop 240mm AIO.

do that before building. If there's still room, however, it's worth considering keeping the stock fans inside the case as well. Most stock fans can be installed in the front or back of the case they come in, so if you're replacing your rear fan with something flashier, it's a good option to push the stock fan to the front of the case to pump up the airflow.

08 CABLE THREADING

With smaller or cheaper cases, which might not have as much space for tucking away your cables, installing your PSU early and threading through power and I/O cables before installing the motherboard can make your life a lot easier. Using cable ties is the way to go here, unless you've gone for a case that includes integrated cable management options, such as Velcro straps for securing cable bundles. Don't forget that you can feed smaller cables directly underneath the motherboard before installing it. Cheaper PSUs are likely to come with a bundle of cables you won't be using, so neatly pack these together with a cable tie, and store them out of sight – ideally underneath the PSU shroud, if your case has one.

09 RIGHT DIRECTION

Fan orientation sounds simple, but it can be easy to get wrong. Most fans include small arrows on the plastic frame, indicating which direction the fan spins in, and which direction it pushes air in; alternatively, just check which side of the fan the power cable protrudes from. If you're mounting multiple fans on a single section – such as two fans either side of a heatsink tower, or stacked fans in the front of your case – make sure they're pumping air in the same direction for maximum efficiency.

10 SPEED CONTROL

Fan speed is an interesting topic; higher RPMs (revolutions per minute) are obviously going to increase airflow, but also produce more noise. Smaller fans demand a higher RPM to work effectively, so don't go with anything smaller than 120mm for your case unless the circumstances demand it. Some cases come with an integrated fan control unit, which enables you to adjust fan speeds on the fly – just make sure you're not leaving them on the lowest setting when you're gaming in 4K.

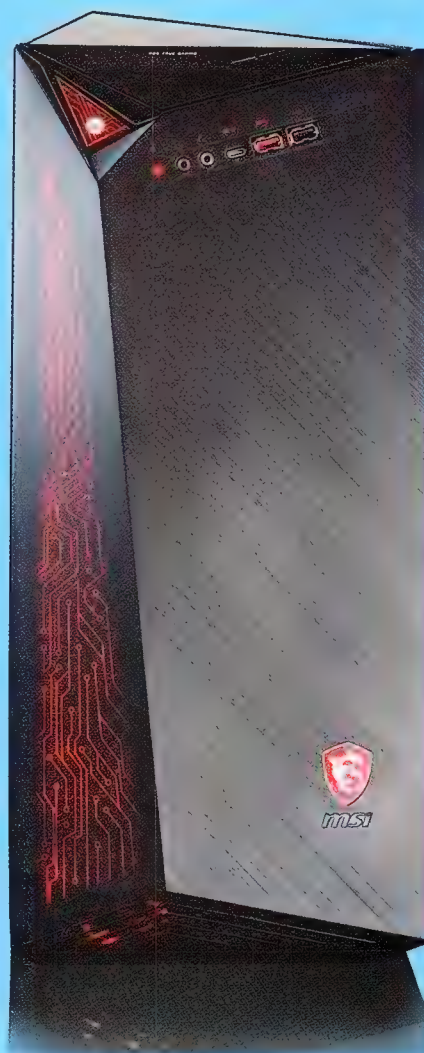
11 BUILD IT YOURSELF?

In broad terms, building your own PC will bleed your wallet less than buying a pre-built system, but this isn't always the case. If you're patient, waiting to snap up decent parts on sale, you can always assemble a powerful computer on a sensible budget, but pre-built models do have their advantages: tidy internals and manufacturer-assured assembly mean that issues such as overheating and component incompatibility are seldom a problem. It can also be a relief to have that manufacturer warranty to fall back on.

A pre-built system lacks a few things against custom builds: they're not bespoke, and many are needlessly tricky or even impossible to upgrade. If you're looking for the ideal purpose-built PC, you're better off taking the leap and assembling it yourself. Bulk-purchasing components means that pre-built systems can contain high-end parts at a relatively low premium, and there's a certain degree of assurance that the chosen parts will function optimally together. Many come with unique cases that can't be purchased standalone. These are often supremely nice to look at, but a challenge to actually work in should you want to fiddle around with your rig's guts.

Pre-built systems have come far in the past few years. Recent offerings from Aussie companies such as PC

Case Gear, Mwave, Scorptec, TI Computers and PLE are typically powerful and effective, and are available at a wide variety of price points. Higher-end pre-builds are generally a better option – if you're assembling a PC on a tight budget, DIY is often the way to go. Ever evolving standards mean that prices are always in flux, and trying to build your own PC from scratch can be a potential minefield of bad prices.



"Pre-built systems can have some very elegant cases that are otherwise out of reach."

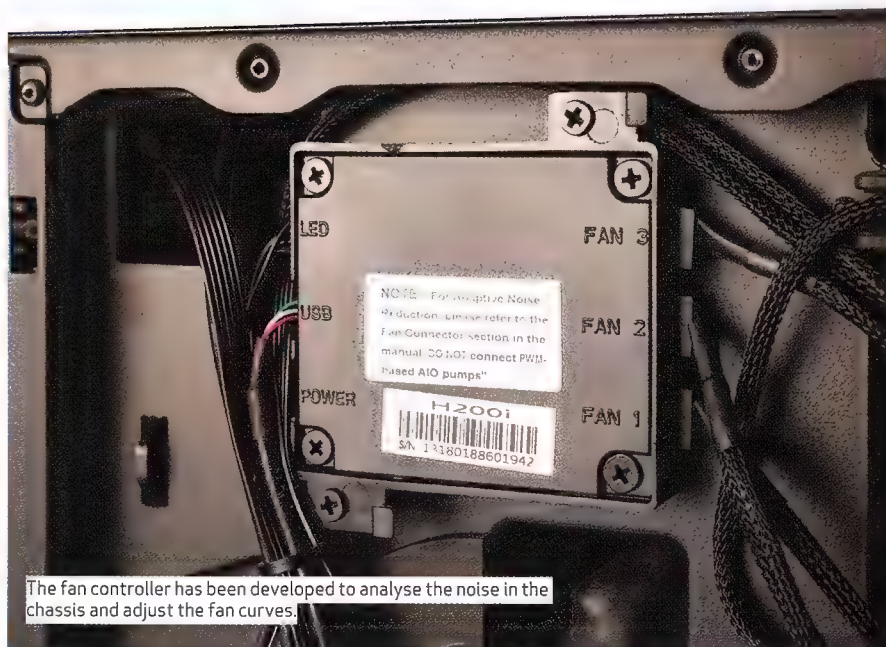


12 TOO RGB, OR NOT TOO RGB?

RGB lighting is a topic of much debate both at the APC office and on every single computer hardware forum in existence. There's no denying that filling your build to the brim with LEDs can result in a computer that looks like a cross between a sports car and the most expensive *Star Trek* prop ever, but "expensive" is often the operative word there. It's tempting, too. RGB coolers and fans are becoming more prevalent, so it's easy to be drawn in. Those little additions often add up, though.

A pair of premium maglev case fans from Corsair will run to around \$35, while their RGB counterparts can raise that to \$50 or more. Stick-on LED strips aren't too expensive, but can require expansion kits and RGB controllers that will drive up the price. And, of course, you need a case that shows off your multicolored lights – that means tempered glass or even RGB-focused cases, which could result in a less than sensible total cost. At the very least, control software for most branded RGB gear is free to download.

A good rule of thumb when it comes to RGB is to simply ask if you could get the same performance for a cheaper price without the lighting. If you're going to spend an extra \$50 on a case just because of its glass front, consider how much time you're going to spend looking at your PC against how much time you're going to spend looking at the screen. Putting that money toward a superior monitor is always going to serve you better, especially if you're operating on a budget. But if you've got the money to burn, or you come across an RGB piece that outperforms one without, go right ahead and turn on the rainbow.



The fan controller has been developed to analyse the noise in the chassis and adjust the fan curves.

13 PROCESSOR COOLING

Case fans are great, but CPU cooling is crucial in keeping your rig running under stress. There are three options: a traditional air cooler, full liquid cooling, or an all-in-one (AIO) cooler unit that uses both fans and liquid coolant. The first is typically what comes in the box with your processor – these stock coolers are decent enough, and generally not too hard to install, but don't provide high-level cooling. Complete liquid-cooling loops are tricky to install and cost significantly more, though their performance is often unparalleled. AIO coolers are frequently the best option, providing top-notch cooling with a large degree of flexibility, and little to no maintenance. If you're overclocking your CPU, a good AIO cooler is heartily recommended.

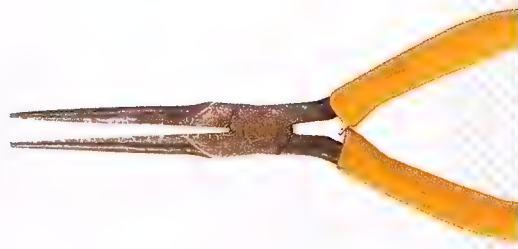
14 AIR PRESSURE

There are two possible options for maintaining good air pressure inside your build. Balanced air pressure means the case draws in a similar amount of air to how much it pumps out, keeping airflow steady, and temperatures lower. Positive air pressure means your build draws in more air than it pumps out – this can prevent air entering through unfiltered sections of the case, potentially reducing dust build-up. The difference in temperature is relatively minimal, but if you're serious about cooling, balanced air pressure is generally better – test both out using stress-testing benchmarking tools such as Prime95 if you're curious about the results. There is a third option – negative air pressure, the (surprise) opposite of positive pressure – but you want to avoid this, as it tends to result in build-up of dust inside your case.

Keeping your processor cool when under load is essential, and there are several options you can consider.



GRAB YOUR GEAR: CLOTHES MAY MAKE THE MAN, BUT TOOLS MAKE THE PC BUILDER. HERE ARE SOME OF THE MOST HELPFUL ITEMS YOU'LL COME ACROSS.



15 SCREW BOWL

You can splurge on a magnetic bowl for your screws if you want, but really, any little bowl will do the trick. Even a simple kitchen ramekin will work. The important thing is keeping all of your screws in the same place when you're working on a rig; they can be easy to lose, and that only leads to frustration.



16 THERMAL PASTE

Most coolers come with paste, but our go-to is Noctua's NT-H1. It's not very expensive, and Noctua coolers come with some – one tube is good for multiple applications, and it's a pleasingly thick, non-conductive paste that does a good job of transferring heat. You only need a flat, pea-sized dot on normal CPUs.



17 CABLE TIES

These are the most important thing for any PC builder. They're dirt cheap online, and come in a variety of sizes for different uses, primarily for organising the internals of your rig. Most cases have slots on the frame to strap down cables, and they can be used for tying up loose wires to keep your case tidy.



18 ISOPROPYL ALCOHOL

If you're planning on switching out your processor or cooler, you're going to need this stuff. It's inexpensive, and nothing is more effective when it comes to cleaning off dried thermal paste or dirty smudges on metal. As an added bonus, it's one of the few substances that isn't going to kill your components if it gets on them. Keep it away from your eyes, though.



19 SCREWDRIVERS

A Phillips-head screwdriver will serve you well in most situations, but a proper set is worth the money. Allen screws, tiny M.2 drive screws, and bizarre proprietary screws all prove frustrating eventually, unless you've got the right tool to coerce them loose. If you've got a bit more cash, mag-tip screwdrivers can be a godsend when dealing with smaller screws inside a case.

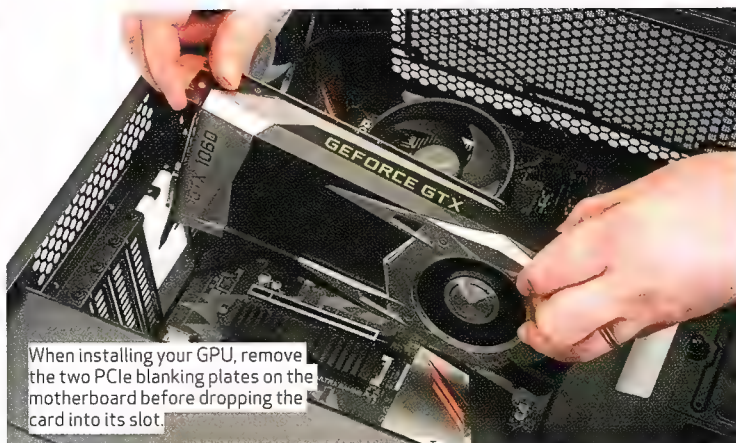
20 SPUDGER

This funky little gadget will set you back less than five bucks, and can come in very handy. Used by the tech-dismantling pros at iFixit for prying apart stubborn components, its thin plastic edge can also be used to gently realign bent pins on AMD processors.





AMD CPUs are easy to install: Just lift the retention arm, and slot the CPU into place, lining up the gold triangle.



When installing your GPU, remove the two PCIe blanking plates on the motherboard before dropping the card into its slot.

21

CPU INSTALLATION

The core of what makes your PC tick, central processing units come from two primary manufacturers: AMD and Intel. AMD CPUs are a little easier to install; simply lift the retention arm, slot the CPU into place by lining up the gold triangle on one corner with the matching corner on the socket, then lower the arm back into place. All done!

Intel CPUs are a smidge more complex, with the pins mounted on the motherboard rather than the processor chip, and a metal bracket that sits over the CPU socket. Lift the retention arm, then slide the bracket out from under the fixed Torx screw, and raise it to reveal the socket. Line up the CPU and place it in the socket, then lower the bracket and retention arm back into place. Intel motherboards come with a plastic cover over the CPU socket; this comes off automatically once the CPU is locked in place.

22

MEMORY INSTALLATION

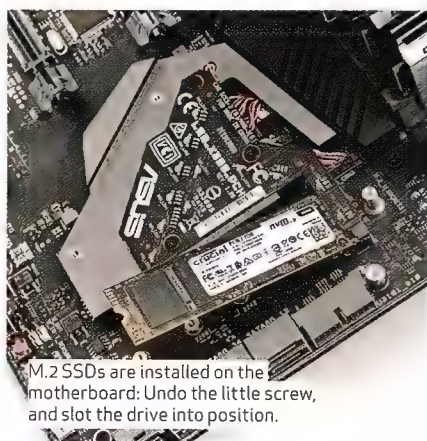
RAM is one of the easiest things to install. Memory slots have either one or two clasps on their short edges, so ensure these are open first. Find the notch on the base of the memory stick, and line it up with the notch in the memory slot, then push it down. It should click into place – the clasps pop shut automatically. Bear in mind that memory slots are usually not in numbered order on the board; they are typically color-coded to indicate which slots use which channels. For dual or quad-channel support to work properly, the RAM needs to be installed in the correct slots. If you're unsure, check the motherboard's manual – it'll let you know exactly which slots to use.

23

M.2 INSTALLATION

If you're using conventional HDDs or 2.5-inch SATA drives for storage, you need to install them in the case, then run a cable from them to the

motherboard. The flashier M.2 SSD format is installed directly on the mobo. Make sure the mounting peg is in the right position for the length of your SSD, then remove the tiny Phillips screw, and fit the M.2 into the drive slot. Apply a little pressure to hold it down, and replace the tiny screw. Many motherboards come equipped with a heatsink for the M.2 drive – this needs to be removed before installation, then returned to the board once the SSD is in place. Don't forget to remove the plastic covering the thermal pad, or



M.2 SSDs are installed on the motherboard: Undo the little screw, and slot the drive into position.

you're likely to smell burning once your build is up and running.

24

GPU INSTALLATION

The graphics card is often the bulkiest piece of gear going on to your motherboard, so take care when installing it. These cards can be heavy, and dropping one on to a board risks damaging both components. Remove the expansion slot covers from your case first, then ensure that the clip on the PCIe slot is released. Like the clasps on RAM slots, it snaps closed once the component is properly installed. Position the GPU with the rear I/O in line with the rear of the case, then gently push it down until you hear the clip. Secure it to the case with screws straight away. This principle can also be applied to other parts that are installed in the PCIe slots, such as sound cards and other expansion pieces. Be sure to use the uppermost slot for your GPU to ensure the best performance.

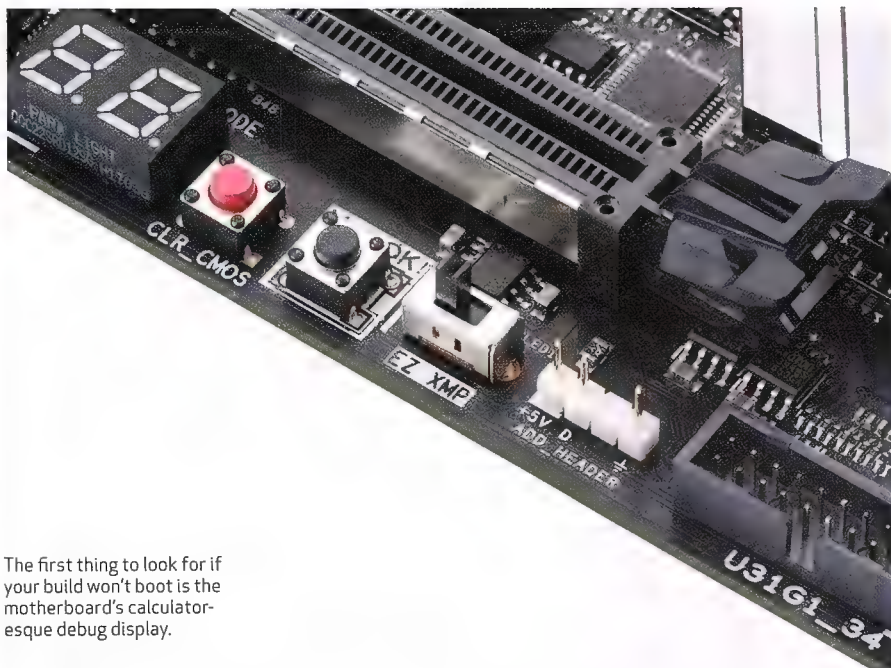
25

FOGGY MEMORY

When a build won't boot, memory is frequently the issue. If you can access



RAM installation isn't much more complicated than pushing it into place, but be sure to get the alignment right.



The first thing to look for if your build won't boot is the motherboard's calculator-esque debug display.

the BIOS, you should be able to see whether the memory is detected properly. If not, or if it isn't seeing all of it, try removing and reinstalling the RAM. Check that the sticks are installed in the correct slots; if they are, but it's still not running, give the additional slots a try. As a last resort, try reseating your graphics card and the CPU.

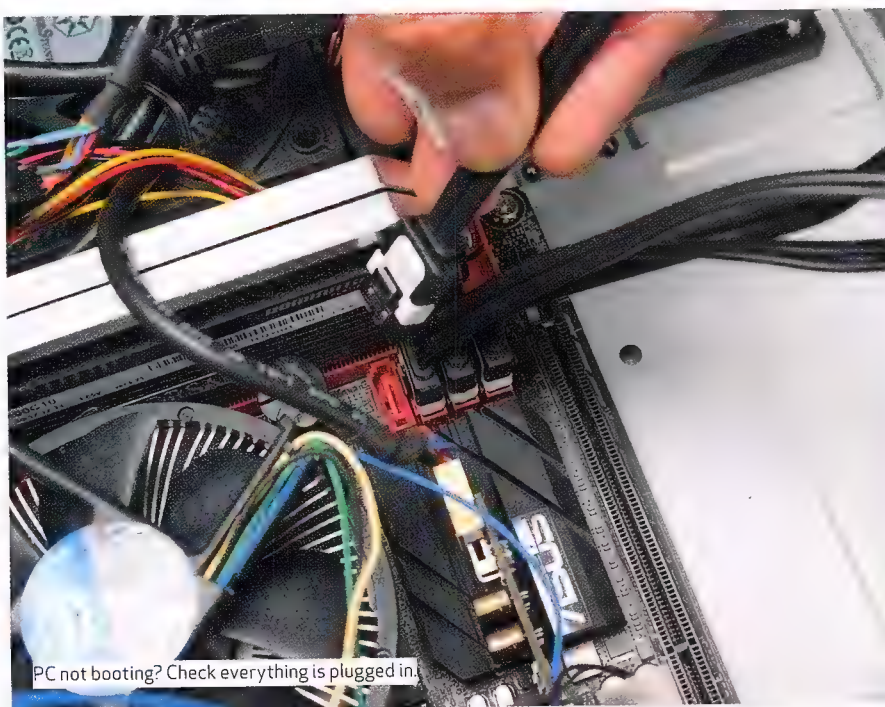
26 POWER ON

The first thing to look for if your build won't boot is the motherboard's debug display. Not all motherboard's have one – it's usually a calculator-esque seven-segment display, although some high-end boards have a small screen

for displaying error codes. Take to Google or consult the motherboard manual, and you should be able to isolate the issue. If you're not sure, or your board doesn't have a display, try these next few tips.

27 ENERGY CHECKS

Is everything plugged in? It sounds silly, but we've all done it. The GPU isn't connected to the PSU, the front I/O wires aren't powered, the boot drive isn't plugged in properly. If everything looks like it's in the right place, but you're still staring at a black screen, try using a different cable for your display; HDMI and DisplayPort cables are notorious for failing when you need



PC not booting? Check everything is plugged in.

31 STAY FROSTY

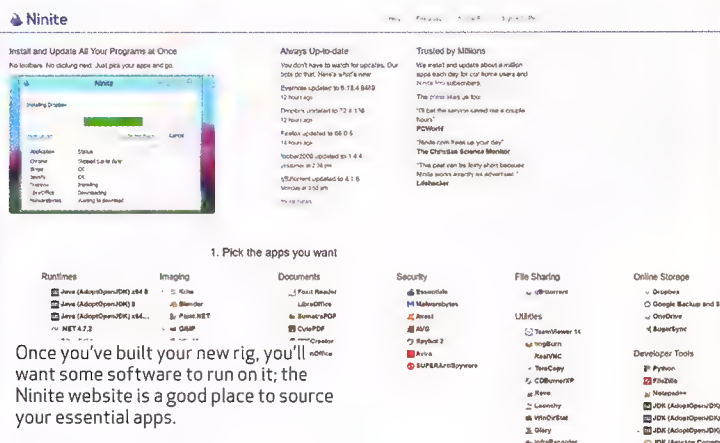
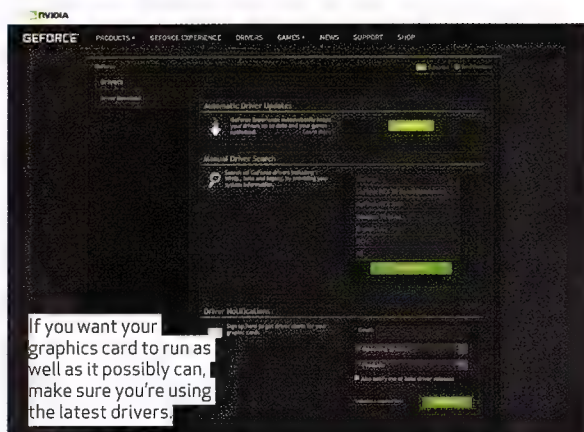
Fully customised liquid cooling can be a monster to do right, but it does come with some major advantages. Lower running temperatures are a given, generating more potential for overclocking, but the key draw for many users is the significant reduction in sound. Fans can be run slower, resulting in less noise. Creating your own liquid-cooling loop is a costly process, though, demanding a budget of several hundred dollars to do properly.

Planning out the build is absolutely necessary if you're going to be installing coolant tubes in your case. Take a side-on photograph of your case, and use your picture-editing software of choice to plan out the positioning of your components and tubes, making sure to ascertain which direction you want the coolant to flow. The larger your case, the easier it becomes; reservoirs and radiators can take up a lot of space. Smaller cases may demand the drilling of holes through metal frames to feed through tubing. Angled fittings can remove the need for bending your tubes; while flexible tubing is an option, hard tubing is easier to secure in place, and tends to look better, too.

The pump needs to be gravity-fed by a reservoir, so vertical installation within your case is required. When it comes to radiators, it's worth having at least 120mm of radiator space allocated per component being cooled. For example, if you want to cool your CPU and your GPU on the same loop, you're going to want a minimum radiator size of 120 x 240mm.



Filling your custom loop with coolant can be a nerve-wracking ordeal.



them most, particularly if you're using cheaper ones.

28 OS INSTALL

Sometimes, it's Windows that's causing the problem. This is particularly likely to occur when transferring an older drive to a new build, generally caused by driver or program conflicts, resulting in a failure to boot. OS files are susceptible to corruption, too. If this is the case, resets and updates aren't likely to help; the only option that might fix the problem is to reinstall Windows completely to your boot drive. We usually recommend installing a fresh copy of your OS with each new build.

29 HARDWARE TESTING

Hopefully it won't come to this, but sometimes components simply die. If you want to do some final checks before calling the RMA line, you generally need a second (functioning)

PC. You can test RAM sticks by plugging in each one separately and attempting to boot. For other components, you need to swap each one out and test it on another motherboard, or replace it with another part you're certain is functioning.

30 BIOS UPDATE

Most modern motherboards support updating the BIOS via the internet, but if yours doesn't, you can usually grab the update file from the manufacturer's site. Download it on to a blank USB drive and plug it into the motherboard, then find the update option within the BIOS's advanced mode. Select 'Update from storage,' locate the file on the memory stick, and you're all set.

32 INSTALLING THE OS

The best way to go about installing a new OS is to grab a copy of Windows from <http://bit.ly/Win10MediaKit>, if you've still got your digital key (or you have a Windows 10 license connected to your Microsoft account). Download the Media Creation Tool and use the 'Create Installation Media' option with a USB drive, then simply plug that stick into your new build, and boot it up. If it doesn't work, head into the BIOS and adjust the boot order, so that the system boots from the USB first. From there, just follow the on-screen prompts to set up Windows.

33 UPDATE DRIVERS

To get your graphics up to speed, head to either the Nvidia or AMD website (depending on your GPU), and download the most recent driver update. If you're using an older motherboard, you'll want to update the chipset first. Just find the product on the manufacturer's website, and grab the latest drivers. You'll also want some additional drivers here;

look for audio and LAN drivers in particular, and remember that the chipset needs to be installed first.

34 LIGHT SHOW

Custom lighting can be a tricky business. It's easy to buy an assortment of compatible RGB components and click a lighting preset in the manufacturer's own RGB control software, but if you want to go truly flashy, you're going to be installing light strips. These aren't too expensive, but you also need adapters and potentially an RGB controller, too. When it comes to installing them, ensure that the strips themselves aren't visible from the windowed side of your case; light should always be shining on your components, rather than out of your case. Find spaces and corners to conceal them, either under the lip of the case's edges or beneath the black border of a tempered glass panel. Using two strips installed at right angles in a corner creates a more even spread of light across your board, but if you're using fully addressable RGB lighting, it's important to ensure that they are synchronised up properly.

35 INSTALLING SOFTWARE

Presumably, you're going to want to put some programs on your shiny new computer. A good one-stop-shop for this is <http://ninite.com>, which enables you to choose from a selection of key programs to quickly and easily download to your C drive. Ninite also keeps these up to date automatically, if you want it to. If you're a gamer, you'll likely have to do some busywork; while Steam is on Ninite's list, other platforms, such as Origin and the Epic launcher, are not. Similarly, if you use higher-end image or video manipulation software, you're going to have to seek it out yourself.

36 TWEAK RAM SETTINGS

You're also going to want to take a look at your RAM settings. Double-check that the memory is running at the correct frequency and CAS timings, then enable



Now that's an RGB light show fit for 2019.



XMP settings if you're overclocking. You can attempt to manually pump this up, too, but be careful – DRAM voltage increases of more than 10% can prove lethal to your sticks.

37 COLOR CODING

Unless you're going for a very specific color scheme, it's generally best to stick to white lighting. This gives your components a good amount of definition, without drowning out any RGB effects your motherboard is putting out. Bright single-color LED strips are likely to just highlight the predominant colors on your components, flooding your build's appearance with blue or red. If your strip allows for brightness adjustment, opting for a slightly more conservative light level is a good call. Addressable RGB is great, provided you ensure that you can synchronise to retain an appealing pattern across your entire build.

38 SEARCH WARRANTY

If you can't work out what's wrong with your build – or if you can, but you can't fix it – there's one more port of call: the warranty. Most brands come with a decent warranty, and some components even come with a lifetime guarantee. Customer service is generally good – if they can't diagnose the issue, you're likely to get a fresh replacement part, provided you haven't done something horribly wrong to the offending component. Don't be afraid to raise a ticket even for minor issues; when it comes down to it, they are the experts. In addition to general design quality and longevity, this is one of

the key reasons we recommend sticking to recognisable brand-name components. If you're not sure when purchasing, check the product's website, and read some reviews on reseller sites. If you can't find many (or any) reviews, tread carefully; don't be lured in by a low price and an obscure manufacturer name.

39 BIOS MASTERY

Knowing how to modify your build's settings in the BIOS is a vital part of proper PC building, enabling you to get the absolute best out of your hardware. We've briefly discussed CPU overclocking on the right, but that's not all the BIOS can do. Fan curves are a great place to start; set a low curve (between 35% and 50% power) for any temperatures below 60°C, then ramp them up. This guarantees a quieter experience when your PC is idling.

40 SPEED UP BOOTING

There's a number of ways to speed up actual use of your PC. Fast boot or boot order settings can be useful to tweak, and ACPI settings enable you to adjust system-level power states and how they interact with input from peripherals. If you've got an Intel board, consider turning on the Rapid Start function, which speeds up resume times from PC hibernation. Remember that your operating system boots faster from an M.2 drive than a SATA one.

41 STOP THE CLOCKS

Overclocking is a complicated business. If you're dead-set on pushing your hardware to the absolute limits, it's best to track down some serious in-depth guides on how to do so without bricking your build. Hardcore overclocking kicks the crap out of your processor and motherboard, which can result in some disastrously high temperatures if you're not careful.

At a fundamental level, overclocking is achieved by raising the frequency at which the processor runs, and increasing the voltage supplied to the components to compensate for the additional power. Different motherboards and CPUs have differing limits when it comes to the overlocks you can achieve; this is done by accessing the motherboard BIOS and manually raising the frequency at which the CPU attempts to run. Depending on the capability of the processor, this could be anything from 0.1GHz to 1GHz more. If you're running a high-end chip, you should be able to squeeze at least 0.5GHz out of it.

Keep raising the operating frequency in the BIOS. At a certain point, the CPU will refuse to boot. To get past this, head back into the BIOS and raise the voltage, usually by 0.05V at a time. Of course, doing this raises the temperature in turn. It's vital to have decent CPU cooling if you're going to overclock; a bundled stock heatsink and fan isn't going to cut it, so be sure to splash out on an upgrade.

If you've got a high-end AIO cooler, though, you can use a stress-testing program such as Prime95 to push your CPU to the limit, and assess the maximum running temps you're likely to hit. Test it between changes to the BIOS settings to ensure that you're not in danger of killing your processor – in theory, though, modern chips should shut off automatically when they reach dangerous heat levels.

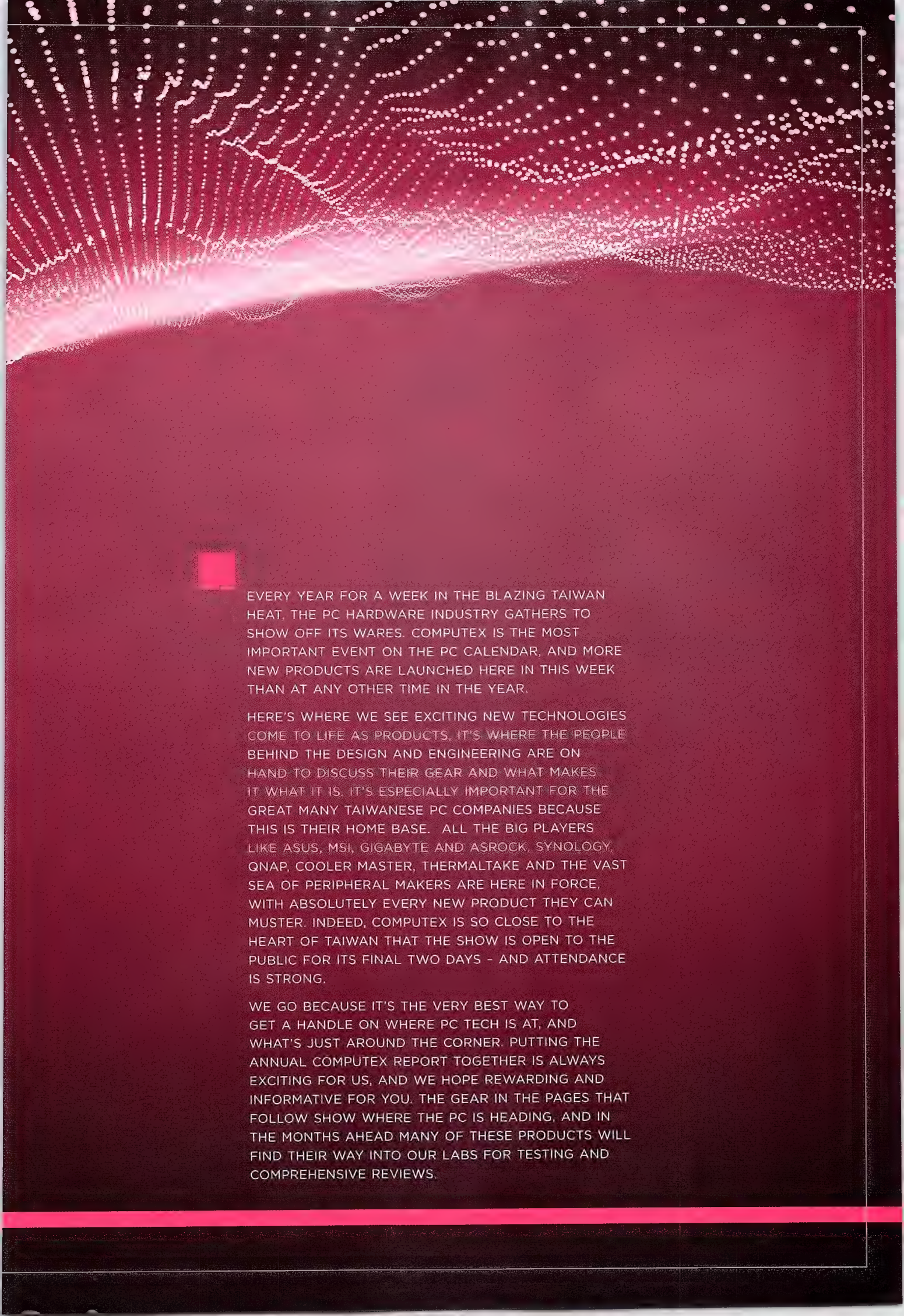
After a while, you'll hit a stage where it's impossible to get the frequency any higher, regardless of the applied voltage. At this point, dial it back by 0.1GHz (this constitutes a more stable overclock), and run some more benchmarks to ensure it isn't about to die on you. If your PC crashes or you hit temperatures that exceed safe operating levels, lower the frequency by another 0.1GHz, and try, try again. ■



COMPUTEX

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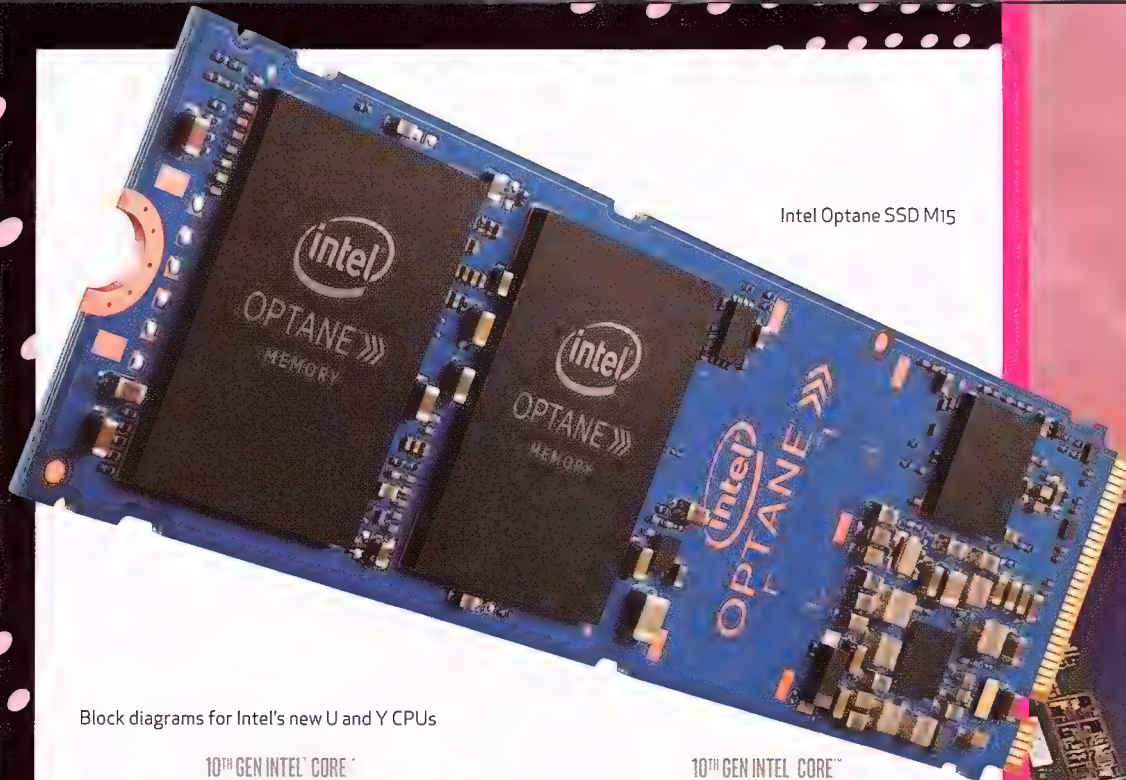
CHRIS SZEWCZYK AND BEN
MANSILL SPENT A LONG WEEK
IN TAIPEI FOR THE BIGGEST PC
SHOW IN THE WORLD. HERE,
WE PRESENT THE MANY NEW
PRODUCTS, TECHNOLOGIES AND
RANDOM WONDERS THEY SAW.



EVERY YEAR FOR A WEEK IN THE BLAZING TAIWAN HEAT, THE PC HARDWARE INDUSTRY GATHERS TO SHOW OFF ITS WARES. COMPUTEX IS THE MOST IMPORTANT EVENT ON THE PC CALENDAR, AND MORE NEW PRODUCTS ARE LAUNCHED HERE IN THIS WEEK THAN AT ANY OTHER TIME IN THE YEAR.

HERE'S WHERE WE SEE EXCITING NEW TECHNOLOGIES COME TO LIFE AS PRODUCTS, IT'S WHERE THE PEOPLE BEHIND THE DESIGN AND ENGINEERING ARE ON HAND TO DISCUSS THEIR GEAR AND WHAT MAKES IT WHAT IT IS. IT'S ESPECIALLY IMPORTANT FOR THE GREAT MANY TAIWANESE PC COMPANIES BECAUSE THIS IS THEIR HOME BASE. ALL THE BIG PLAYERS LIKE ASUS, MSI, GIGABYTE AND ASROCK, SYNOLOGY, QNAP, COOLER MASTER, THERMALTAKE AND THE VAST SEA OF PERIPHERAL MAKERS ARE HERE IN FORCE, WITH ABSOLUTELY EVERY NEW PRODUCT THEY CAN MUSTER. INDEED, COMPUTEX IS SO CLOSE TO THE HEART OF TAIWAN THAT THE SHOW IS OPEN TO THE PUBLIC FOR ITS FINAL TWO DAYS - AND ATTENDANCE IS STRONG.

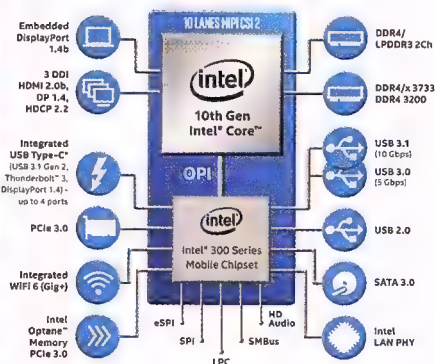
WE GO BECAUSE IT'S THE VERY BEST WAY TO GET A HANDLE ON WHERE PC TECH IS AT, AND WHAT'S JUST AROUND THE CORNER. PUTTING THE ANNUAL COMPUTEX REPORT TOGETHER IS ALWAYS EXCITING FOR US, AND WE HOPE REWARDING AND INFORMATIVE FOR YOU. THE GEAR IN THE PAGES THAT FOLLOW SHOW WHERE THE PC IS HEADING, AND IN THE MONTHS AHEAD MANY OF THESE PRODUCTS WILL FIND THEIR WAY INTO OUR LABS FOR TESTING AND COMPREHENSIVE REVIEWS.



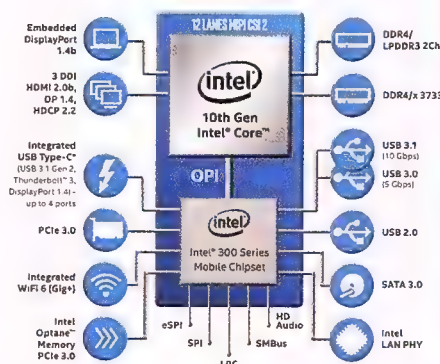
Intel Optane SSD M15

Block diagrams for Intel's new U and Y CPUs

10TH GEN INTEL® CORE™ U-SERIES PROCESSOR



10TH GEN INTEL® CORE™ Y-SERIES PROCESSOR



CPUs INTEL

We came for the CPUs, but left seeing so much more. Yes, Intel at long last unveiled its first properly available 10nm CPUs. They're up to four-core parts intended for laptops. Known as the Ice Lake family, they're officially named 'Intel 10th Generation Core'. Inside is Intel's new Sunny Cove architecture, which boasts built-in support for Wi-Fi 6 (aka 802.11ax) and Thunderbolt 3. They also have new Iris Plus Gen11 integrated graphics.

There are 11 of these 10th gen CPUs in this first release, covering i3, i5 and i7. Detailed specifications and model names were not announced at Computex, but they're in the hands of manufacturers, so it won't be long before we see 10th gen laptops and will know more.

As in the past, Intel has split its new laptop CPUs into two ranges – the Y-series, which will be low power (9W TDP, up from 5W in the last gen), and

the U-series which will have a nominal TDP of 15W, though can run higher. Interestingly, both series will have the new integrated graphics (IGP), so even lowly fanless Y-series devices will have some graphics heft. The IGP will run at up to 1.1GHz and sport up to 64 Execution Units, while the CPUs will have a top turbo frequency of 4.1GHz. All up, the new CPUs are said to have a performance boost of around 18% over the last gen Skylake mobile parts introduced in 2016.

These CPUs are exactly the shot in the arm that Wi-Fi 6 needs and there's no doubt their impending ubiquity will help uptake of the new Wi-Fi standard. It's also nice to know that Thunderbolt 3 will be on pretty much every new 10th gen laptop, too, and having it supported on the chip will mean minor cost and space savings for manufacturers.

The biggest drop for sheer quantity saw Intel announce 14 new vPro CPUs for professional

enterprise platforms, both desktop and laptop. These are all 9th gen products, and are accompanied by 14 more Xeon CPUs with single core Turbo speeds up to 5GHz.

CRANKING HEDT

While HEDT 10th gen CPUs will be announced later, we did get a monster new desktop chip at Computex. In what is probably the last hurrah for 9th gen, Intel announced the i9-9900KS which is a binned 9900K that turbos to 5GHz on all cores and runs at a 4GHz base. This will be a limited part because yields are low.

9th gen is far from over in the mainstream, with the i9-9900KS being one of three new i9-9900 parts, which are accompanied by a pair of i7-9700 CPUs. They have eight physical cores and a base frequency of 3.6GHz.

Intel also showed off a new one-click overclocking utility that really got our attention. The Intel Performance Maximizer is able to





INTEL® 10TH GENERATION CORE™

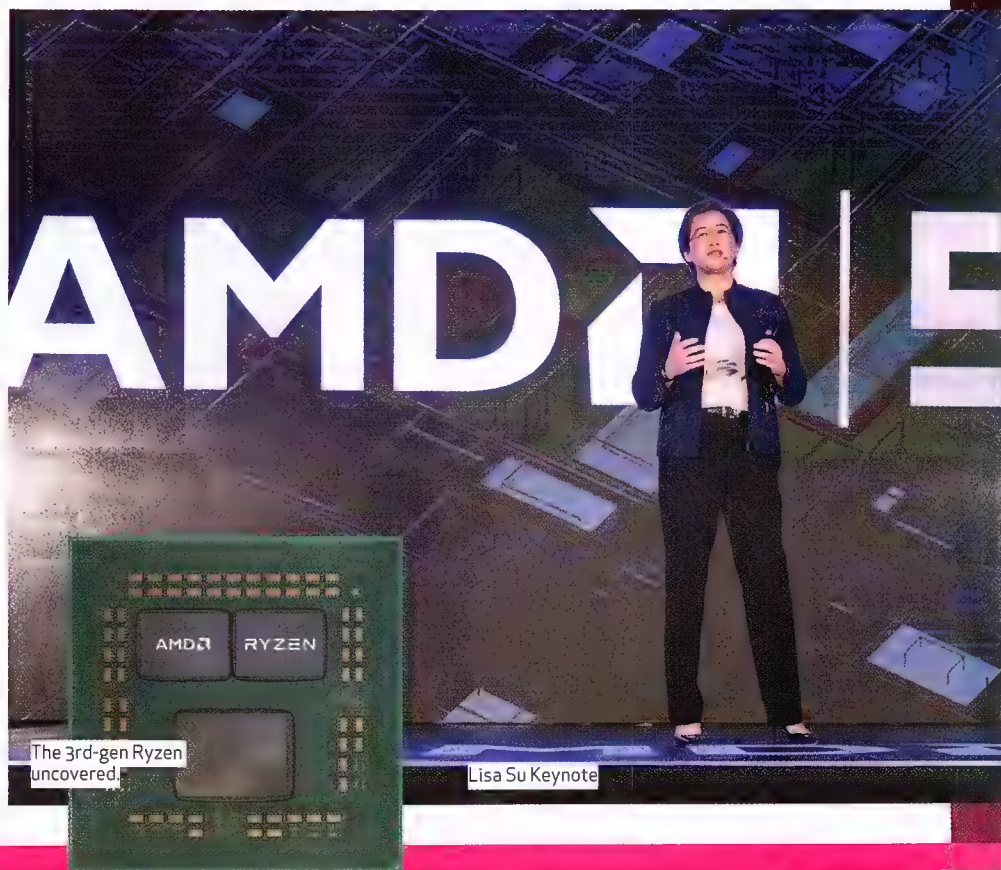
clock each individual core to its maximum limit. We saw it run – which takes a long time in order for it to thoroughly explore the limits of each core – resulting in each of the eight cores on the CPU running at a different frequency. It's due for release in a month or two and will initially support 9th gen K-series CPUs.

A new Optane module was announced, this one combines Optane X-Point memory for its now established task in boosting boot times and acting as an overall cache, with Intel's quad level cell (QLC) NAND supplementing the Optane memory for storage. The Optane H10 will be available in the second half of the year.



CPU's AMD

Computex started with a bang and the spotlight was on AMD, which came right out of the blocks with a pre-show



keynote that set the tone of the entire show and got everyone talking. AMD's CEO Dr Lisa Su revealed the new Ryzen 3rd gen line of CPUs with some exciting details. We saw the first 12-core CPU demonstrated, along with unconfirmed whispers that a full 16-core CPU is in development, all on the AM4 platform, and all are backwards compatible with existing X370 and X470 motherboards, depending on manufacturer BIOS support.

We saw several new models teased. First up was the Ryzen 7 3700X. It's an 8-core 16-thread 7nm CPU that has a base clock of 3.6GHz and a boost clock of 4.4GHz. "That's similar to a 2700X" we hear you say, but the impressive reveal is a TDP of just 65W. Compare that to the 105W TDP of the 2700X and it's clear that AMD's 7nm tech looks pretty solid from what we've seen. We're wary of placing too much emphasis on unverified benchmarks, but AMD claims the 3700X is up to 15% and 18% faster at single and multi-threaded Cinebench performance vs. the 2700X. We'll reserve judgement until we test it ourselves, but if these numbers hold true, the US\$329 chip could give Intel something to sweat about.

Next up is the 3800X. It's fundamentally similar to the 3700X but features higher 4.5GHz boost and 3.9GHz base clocks at a 105W TDP. AMD compared it favourably to an Intel i9-9900K on stage using

the PUBG game. Its price was revealed to be US\$399.

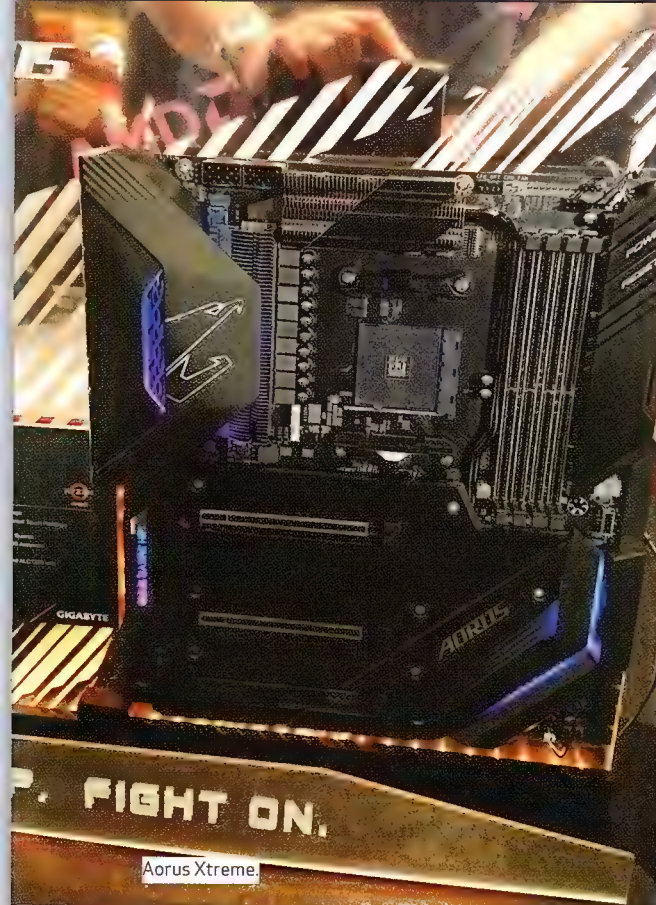
Given the core arrangement of Ryzen CPUs, it's only logical to assume we'd get models beyond eight cores, and so we did. The Ryzen 9 3900X is a 12-core, 24-thread powerhouse with a 3.6GHz base clock and 4.6GHz boost clock, still at a very respectable 105W TDP and it's priced at just US\$499.

Just a week after Computex, AMD also announced the new king of the family. With 16 cores and a 4.7GHz boost clock for US\$749, the Ryzen 9 3950X is potentially the fastest consumer CPU in the world – and we'll be testing one very soon!

EVEN MORE CORES

It's rather incredible to think that we'll see 12 and 16 core CPUs on AMD's mainstream AM4 platform. Content creators certainly have something to look forward to, without the high cost associated with Intel's X299 and AMD's Threadripper platforms.

AMD isn't just focusing on the consumer this year though. Dr Su's keynote gave us the best look yet at its upcoming Epyc range of CPUs, including a 64-core 128-thread behemoth codenamed Rome. Its aggressive pricing is expected to put a significant dent in Intel's stranglehold on the enterprise segment. Rome, along with Radeon Pro graphics, are being used to build a 1.5 exaFLOP supercomputer, expected to be the world's most powerful, to be completed sometime in 2021.



Aorus Xtreme



Aorus X570 Pro Wi-Fi

"Of course there will be a full Aorus range including Master, Ultra and Pro models, and even the Aorus X570 Pro Wi-Fi ITX board for the small form factor fans."

MOTHERBOARDS

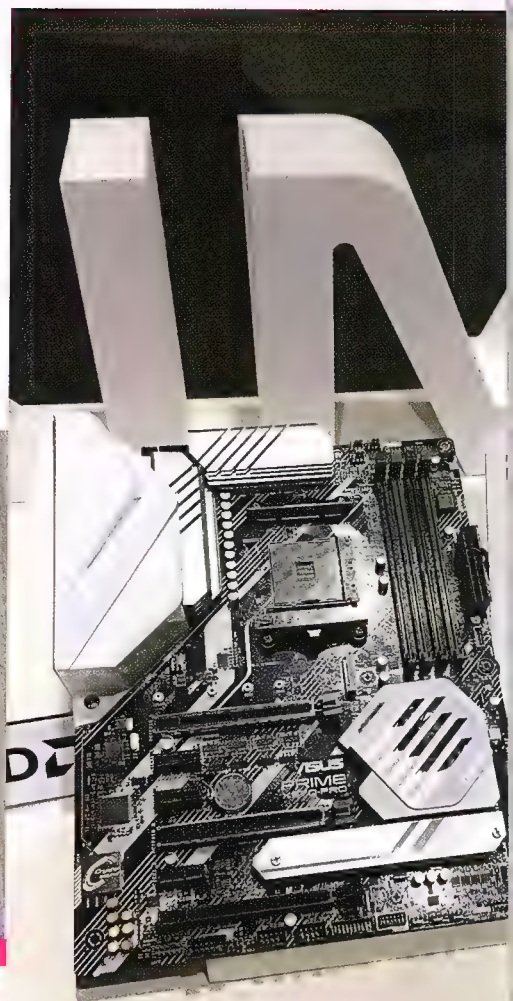
Accompanying the release of Ryzen 3 is a new chipset, logically dubbed X570. Motherboard manufacturers proudly showed off their top to bottom lines of X570 motherboards, and boy, do they have some top shelf specifications and designs! The most noteworthy new feature is support for PCI Express revision 4.0. PCIe 4.0 doubles the bandwidth of PCIe 3.0 meaning there's

more bandwidth for next generation graphics cards, but more importantly, the ability to support more auxiliary controllers including SATA, USB, networking and other functionality that would otherwise require two or more PCIe 3.0 lanes.

Our first stop was the Gigabyte Aorus press conference. Our eyeballs are still recovering from the sun-like lights shining in our eyes, but once we could see again, we were treated to some truly feature-packed Aorus X570 motherboards. At the head of the pack



ASRock X570 Taichi



ASRock X570 Aqua

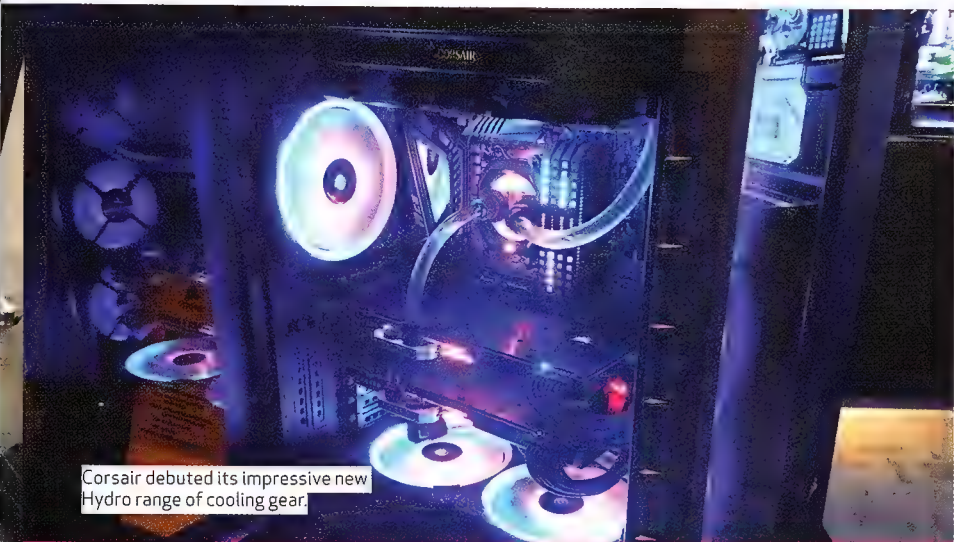


Asus ROG Crosshair VIII Formula



Asus TUF Gaming X570-PLUS (Wi-Fi)

Asus Prime X570 Pro



Corsair debuted its impressive new Hydro range of cooling gear.



Hydro is lookin' good in RGB.

Of course there will be a full Aorus range including Master, Ultra and Pro models, and even the Aorus X570 Pro Wi-Fi ITX board for the small form factor fans (myself included).

PCIE 4, TAKING ADVANTAGE

Our next visit was to MSI. We would expect MSI representatives to take us straight to its gaming boards, but surprisingly (and refreshingly) our attention was drawn towards the X570 Creation. This board has all the high-end features you'd expect, including 10GbE LAN, 802.11ax Wi-Fi, a PCIe 4.0 add-in card for even more M.2 support, strong cooling and notably, a massive array of USB ports, with 14 on the back panel alone! Not bad at all for a supposedly 'mainstream' Socket AM4 motherboard.

MSI also proudly showed off a range of gaming motherboards, including perhaps the most loaded X570 board of all, the X570 Godlike. It adds gamer-centric features such as Killer networking, an onboard OLED information screen, attractive RGB and add-in M.2 expansion and 10GbE LAN cards.

It's not all about the high-end though. MSI also showed the mid-range Ace, Pro and Edge models as well as the X570 Gaming Plus, which the company expects to be one of its highest volume boards targeted at gamers looking for something with the essentials.

It wouldn't be Computex without the massive presence of Asus and we were shown a full range of X570 motherboards from its sub brands including ROG, TUF and Prime.

Topping the list is the ROG Crosshair VIII Formula. This board is aimed at liquid coolers with its EK VRM water block, array of customisable controls and sensors and full cover back plate on top of an impressive specification list. The Crosshair VIII Hero will no doubt find its way into many a gamer's rig. It still has a very strong VRM solution but doesn't include the water cooling centric features of the Formula. Asus also caters for the more budget conscious gamers with the ROG Strix models.

Asus' TUF product ecosystem has gathered quite an impressive list of industry partners, with its focus on affordability and reliability. It's possible to build an entire yellow-and-black-themed TUF system. The TUF Gaming X570-PLUS (Wi-Fi) looks like it will be a solid board for the budget conscious gamer desiring something simple and reliable.

If gaming and excessive bling aren't your thing, then the Asus Prime X570-PRO is probably going to be more your speed. It ticks all the important boxes and looks nice and subtle with its white themed design. Finally, given the increase in core counts for 3rd-gen Ryzen CPUs, workstation users with mission critical workflows will be looking for something suitable. The Asus Pro WS X570-ACE brings all the X570 features to the table and adds ECC memory support and x8/x8/x8 triple GPU support.

THE \$1,500 MOTHERBOARD?

Asrock also had some surprisingly innovative wares, including the

US\$999 X570 Aqua board! Yes, if it ever comes to Australia, this could be a \$1,500 motherboard! It's a 999-piece limited edition product that features integrated CPU and chipset water blocks. It looks gorgeous and comes with almost every conceivable feature, including dual ThunderBolt Type-C ports. Notably, the board lists support for memory speeds of up to DDR4-4666. Everything points towards 3rd-gen Ryzen having much improved memory support.

Asrock's Taichi series has been well received with its unique aesthetic and focus on essential features and value. The X570 Taichi departs somewhat from the line's previous simplicity and adds quite a bit of RGB lighting and a large black heatsink across the lower part of the board. Expect this one to still offer good bang for buck.

We noted several Asrock boards featured an internal DisplayPort, which is connected to a back panel Thunderbolt port for TB display support. Interesting!

The motherboard manufacturers showed off their existing lines of Intel Socket 1151 and 2066 models, though there was little that was new. We'd expect a new motherboard platform when Intel launches its 10nm desktop CPUs in the future.

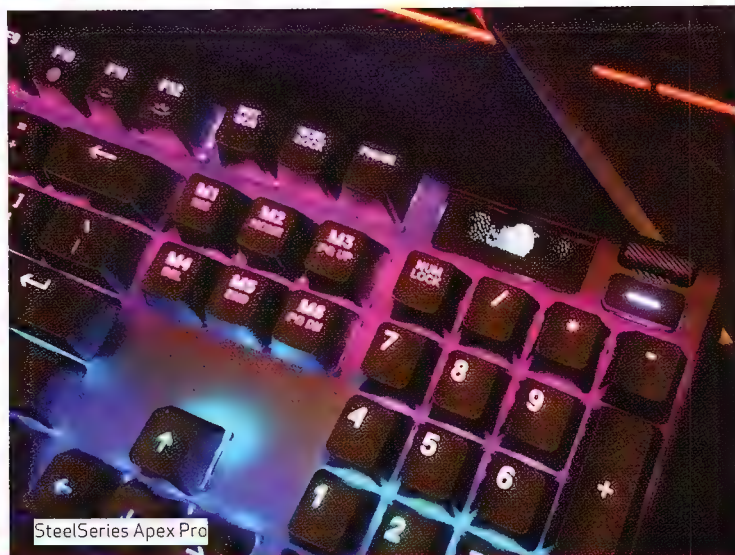
GRAPHICS CARDS

With Nvidia's Turing lineup having already taken shape, there wasn't too much on display from Nvidia's partners that we haven't seen before. One notable exception was a special 10th anniversary GeForce RTX 2080 Ti Lightning Z from MSI. The card comes with a useful OLED display that can show various monitoring info, it has a rather sexy genuine carbon fibre back plate and uses a binned die for the best overclocking performance. It's not expected to be cheap, though we still want one!

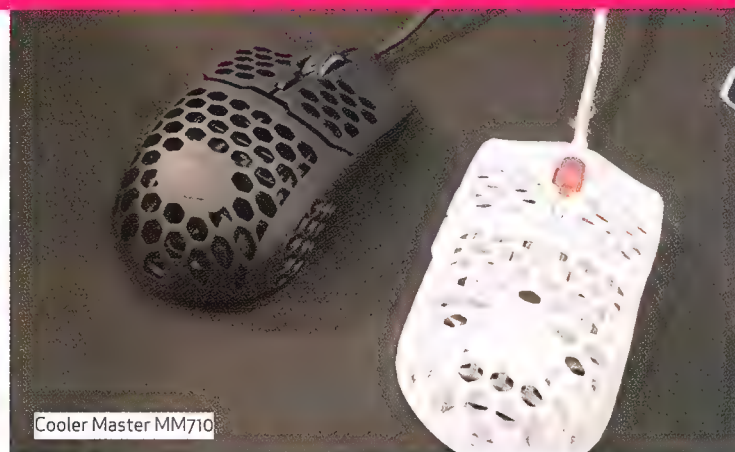
We did get a sneak peek at AMD's Navi graphics cards, which are scheduled to launch in July. Details were scarce at Computex, but we saw it all just a few weeks afterwards - see the feature following these pages for that report - but, in short, they'll be built with TSMC's 7nm process, support PCIe 4.0, GDDR6 and receive a new naming scheme; the Radeon 5000 series. They're built with an all new ground-up architecture called RDNA, replacing the ageing GCN architecture found in AMD models going back several generations. If AMD's claims of 1.25x performance per clock (tied to increased clock



HyperX Fury DDR4



SteelSeries Apex Pro



Cooler Master MM710

speeds) and 1.5x performance per watt hold true then AMD could have a very competitive range on its hands (price depending). Oh did we mention that Navi will appear in the next generation of PlayStation? That's great news for AMD.

MEMORY

DDR4 memory technology has pretty much stalled in recent years. Bling is the name of the game, with memory vendors proudly showing off their bold new designs. New memory was on show from the likes of Adata, G.Skill and HyperX. The HyperX Fury grabbed our attention. Yes it's fundamentally the same DDR4 you could buy last year and the year before that, but the RGB implementation was classy. It features something called Infrared Sync which we're told allows precise synchronisation of RGB effects across all of the modules. We aren't going to argue, as the various effects looked lovely.

We really look forward to the introduction of DDR5 memory, which we're likely to see introduced sometime next year.

PERIPHERALS

Computex wouldn't be Computex without a comprehensive array of keyboards, headsets and mice on show. Many manufacturers displayed their fully custom designs, featuring in-house designed and built switches.

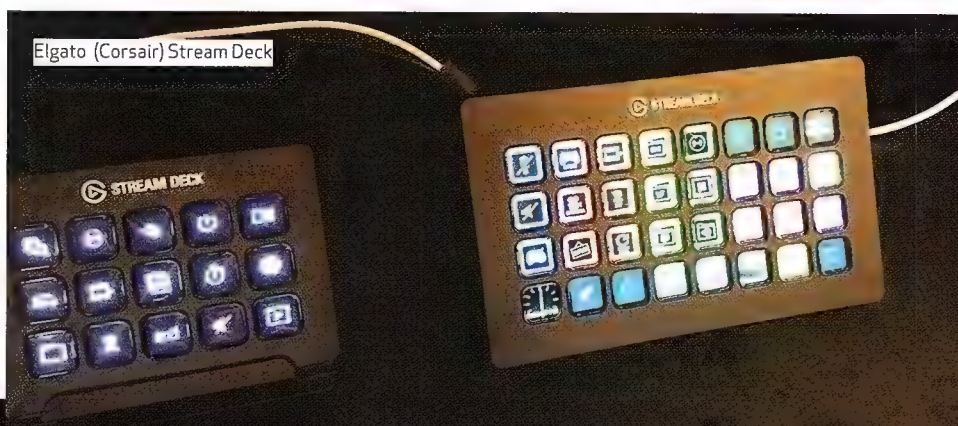
SteelSeries revealed its 'adjustable activation' switches. In an area where innovation can be sometimes lacking, this really impressed us. The Apex Pro is available in both full size and ten-keyless variants. In addition to the adjustable switches, they both feature an integrated OLED display, per-key RGB lighting, aluminium construction and a magnetic wrist rest.



Cooler Master SK851



HyperX Alloy Origins



Elgato (Corsair) Stream Deck

ature Chassis

uilt like a bird's skeleton; light,
d awaiting to fly.



In Win Yong



In Win 925



Cooler Master SL600M



"Lian Li showed some amazingly customisable cases including the Odyssey X which can be configured so much, it becomes almost unrecognisable."

Cooler Master revealed its MM710 ultra-lightweight gaming mouse. It weighs in at an incredibly light 52 grams. Supposedly, it's the world's lightest. If you're seeking the fastest and most responsive movement possible, it's well worth a look.

Continuing the content-creator theme that ran across the whole show, CM revealed its SK851 Bluetooth low profile mechanical keyboard. It features Omron low profile switches that are just 7.4mm tall, meaning the entire keyboard is very slim. It's one I'd be more than happy to have sitting on my desk.

Elgato had a presence in the Corsair suite. The company showed off its Stream Deck. The new Stream Deck XL features a total of 32 shortcut keys, each of which is individually programmable. It's aimed at streamers, but all sorts of users should find it useful. You can start and stop various tasks, trigger on screen functionality, adjust lighting or audio levels and a whole bunch of other cool things that are frequently accessed.

Kingston and HyperX had an impressive line-up of headsets on show, including a high-end planar driver model, the Cloud Orbit S. The Audeze planar drivers deliver excellent sound quality as well as 3D

positional sound and it should make an excellent set of regular headphones too. It's compatible with PC, consoles and mobiles.

HyperX has developed its own in-house switches and these can be found in the Alloy Origins keyboard. We're told these switches approximate Cherry Reds, making them likely to appeal to gamers who prefer the high responsiveness typical of a red switch. HyperX has tweaked the red design further, however, shaving the travel distance and actuation point down to 3.8mm and 1.8mm respectively. Accompanying the Alloy Origins was a very appealing and very squishy wrist rest that felt like memory foam. It was a pleasure to type with.

CASES

We could use this entire report to talk about some of the amazing cases on display at this year's show.

In Win had some seriously impressive cases out, catering both for the RGB crowd or to those who prefer something a bit more subtle. The In Win 925 was probably this writer's favourite case in the whole show. It's built like a battleship and is simply gorgeous. If cloth is your

thing, how about the simplistic but pleasing Alice concept chassis? It's amazingly lightweight and unique.

Alternatively, if you treat your PC as a piece of art, there's the Yong chassis, but at US\$4,000, it's not for everyone.

Thermaltake didn't have a whole lot that was new this year, though the A500 has impressive build quality and subtle good looks that appeal. The Level 20 cases still look great if you want to show off your PC.

Cooler Master's SL600M stood out with its darkened tempered glass, but perhaps our favourite CM case was the H100M Mini-ITX case. It has a 200mm front fan for good airflow, a carry handle and can house a full-sized ATX power supply.

Lian Li showed some amazingly customisable cases including the Odyssey X, which can be configured to such a degree that it becomes almost unrecognizable as the same case. The Lancool II will be affordable, so we're told. It features all kinds of removable panels for placing radiators or hiding cables and SSDs.

Lian Li showed the most impressive desk of the whole show, the DK05-F. It's a very sturdy and solidly built unit capable of housing two full systems. It comes with customisable servo height adjustment and perhaps its most unique feature, the ability to switch

Cooler Master Master Air Maker

Thermaltake P200 chassis

"The P200 chassis is essentially a mounting plate that functions as a reservoir and open air case at the same time."

Corsair Hydro X Water-Cooling Range

the glass top between transparent and opaque modes. There's even three mounts for triple monitors and the whole unit is rated to hold 80kg. It's a really lovely unit... it's going to cost US\$2,000 though!

COOLING

There are always plenty of cooling products on display at Computex. Corsair revealed its new Hydro X water-cooling range, complete with waterblocks, fittings, tubing and pumps. Corsair has a custom configurator website that advises which parts to buy depending on your

system configuration. It's definitely easy for those who might be daunted by building a custom loop. Corsair also had some gorgeous systems on display.

The Cooler Master MasterAir Maker is probably the most impressive air cooler we saw. It utilises a U-shaped vapour chamber technology instead of the traditional heatpipes to dissipate the heat from the CPU. This means greater surface area and is the kind of thing that makes us wonder why it isn't standard for air coolers.

Thermaltake showed off a truly unique cooling product – a water cooling reservoir that's also the chassis itself! It's very much in the prototype stage though. The P200 chassis is essentially a mounting plate that

functions as a reservoir and open air case at the same time. It won't appeal to everyone, but it's great to see case and cooling companies think outside the box and show off something unique and innovative.

LAPTOPS

Computex is always chock full of new laptop designs, and this year was no different. While gaming remains a strong focus, there was a definite change in theme this year, with content creation being at the forefront of many manufacturers' booths. Slim, lightweight and silver

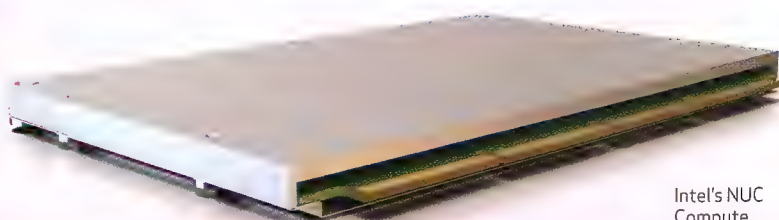
Quake 2 RTX

Nvidia announces its new Studio laptop platform.

Nvidia Studio laptop by Razer



Intel detailed its new Athena platform for laptops.



Intel's NUC Compute Element 1

was all the rage. Perhaps the goal is to entice some of the Mac legions over to the PC ecosystem...

At the head of this new charge was Nvidia's Studio Laptop announcement. Studio Laptops were on display from all the major OEMs. They're aimed at professionals and content creators who want both GPU grunt and portability. Nvidia Studio Laptops include RTX GPUs, which means you get real-time ray tracing, AI processing and an extensive array of validated software for all sorts of production oriented tasks. You'll also get special extensively-tested drivers that are validated with many major production suites. Expect more coverage of Studio Laptops in upcoming issues.

ULTRABOOK 2.0

As excited as we are for Intel 10th gen, we were more impressed in a hands-on sense with Intel's debut of the Project Athena laptop specification, along with other new form factors unrelated to Athena. You could consider Project Athena to be 'Ultrabook 2.0'. It lays out a series of requirements and optional but not essential specs for its partners to follow as they produce new machines, though unlike the original ultrabooks, Athena machines won't carry a specific moniker. The specs will be revised each year and the version-1 guidelines cover several areas. They must wake from sleep in under a second and have online Wi-Fi 6 and optional Gigabit LTE

connectivity instantly available. Thunderbolt 3 must be supported, and Athena machines will have at least 8GB of dual channel RAM and at least 256GB of NVMe or Optane SSD storage. Interestingly, having Optane is not considered one of the essential Athena requirements. No minimum dimensions are set, but it's expected that Athena machines will all have touch screens and be thin and light. All candidate Athena PCs will need to be submitted to Intel by its manufacturing partners for final approval. Several early machines from Dell, Acer, HP and Lenovo were displayed, and are expected to hit the shops soon.

SIMPLER AND SMARTER

Building upon its mighty success with its NUC PCs, Intel announced NUC Elements, which is a CPU and memory module the size of a credit card. It's bound to be a winner with low cost laptop and device manufacturers, as it can form the basis of a quickly designed and produced device.

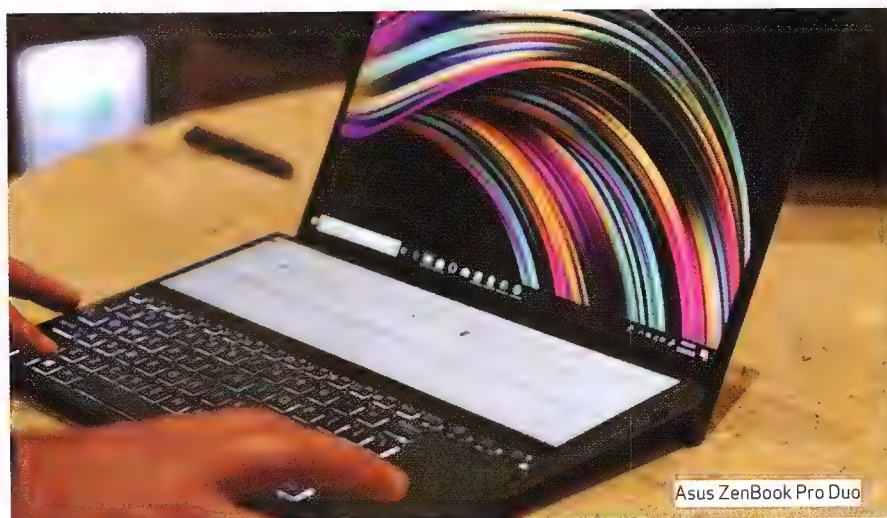
AI was an oft-heard buzzword at this year's Computex for Intel, with its new Movidius AI dev kit in the hands of partners. This M.2 format unit is essentially a mini CPU with 16 cores which will handle tasks like face and object recognition, or computing tasks like relieving the CPU and GPU of handling video calls. Partners can choose to install the M.2 card in PCs, or engineer the chip itself onto motherboards.

OLED INCOMING

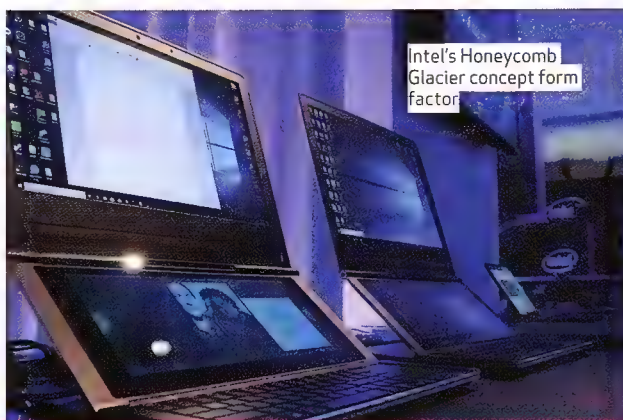
Gigabyte's Aero laptops really impressed us with its OLED screens. The deep blacks, colours and contrast from these amazing displays is simply stunning. The Aero 15 OLED comes pre-calibrated by X-Rite Pantone before leaving the factory, features 100% DCI-P3 gamut and HDR 400. Gorgeous.

Probably the most impressive laptop we saw at Computex 2019 was the Asus ZenBook Pro Duo. Decadent is a word we'd use to describe it. It features a full-width 32:9 4K screen along with a 4K UHD OLED main display. You can use it with a stylus. This amazing machine is actually the first real product to come out of Intel's 'Honeycomb Glacier' companion screen project, which it has collaborated with partners on, with the Asus team producing this beauty. It really was stunning to behold, and compared to last year's screen touchpad, this new model really is next level, with genuine rea-world applications.

Even more impressive was a prototype Honeycomb machine developed in-house by Intel that,



Asus ZenBook Pro Duo



Intel's Honeycomb Glacier concept form factor



Alienware Legend m15



Intel Twin River 3 concept

because it's the way these things usually go, probably won't ever become an actual product – though we can hope. This one is another companion screen laptop, but the second screen can be raised up to produce an almost vertical twin-screen array.

'Ambient' was another Intel concept laptop, the idea here being it's always ready to respond to the user's needs by monitoring human presence and its surroundings using a 180° camera, voice monitoring and secondary displays on the laptop front edge.

A fully dual-screen concept called 'Twin River' also impressed. We're reassured seeing the physical keyboard, as typing on a screen (no matter how good) will always be a second rate experience. All up, it seems that there'll come a day when any laptop without a second screen will either be budget or old.

DELL & ALIENWARE

Over at Dell we saw many new laptops, including from Alienware. We hunted down the new XPS machines – the new 13-inch 2-in-1 was the highlight. Here, Dell's switched from a 16:9 to 16:10 aspect ratio screen – but the focus for that change wasn't screen real estate so much, but how the larger screen translates to a larger base area which allows for a larger keyboard with bigger keys and more spacing between them compared to the previous model.

Alienware showed off its mighty Legend m15 and m17 models. Strutting that fine balance between over-the-top gaming laptop design and something an adult wouldn't be ashamed to own,

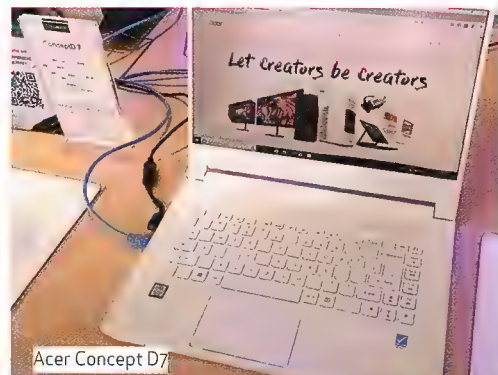
they looked amazing, with a beautiful magnesium finish. The screen options go all the way up to a 144Hz OLED panel, but it won't support G-Sync, with the explained reason being that G-Sync requires the discrete GPU to be powered on at all times, which negatively impacts battery life if you just need IGP for non-gaming tasks.

MSI showed off its GT76 Titan, a true desktop-replacement laptop. How does a desktop i9-9900K and RTX 2080 sound? It's got the cooling to match. Hands down, it's the most powerful laptop we've seen yet, but at 4.5kg it's not exactly a lightweight.

Acer surprised us with a very comprehensive line-up of models. The eye catcher was the Concept D9. It features a screen that you can flip or reverse like a 2-in-1, but on steroids. Also noteworthy was the surprisingly compact Concept D7. It features a lovely 4K, 100% Adobe RGB screen and Max-Q GeForce RTX 2080. Amazing in such a small package.

MONITORS

There was plenty of exciting new monitor tech on show all over Computex 2019. We'd hoped to see more Big Format Gaming Displays that were shown last year come on sale, but we're told they are still coming. The Asus ROG Swift PG65UQ uses a 64.5-inch 8-bit 4K Ultra-HD AMVA panel with HDR support and up to 144Hz refresh rate. It's gorgeous and should hopefully arrive later this year.



Acer Concept D7



Acer Concept D9



MSI GT76 Titan

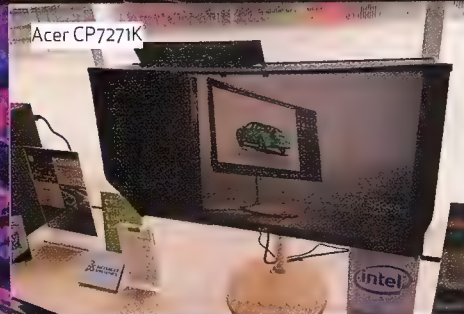
AORUS Gaming Monitor Series



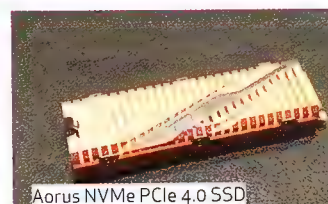
Aorus Tactical Monitors



Asus ROG Swift PG27UQX



Acer CP7271K



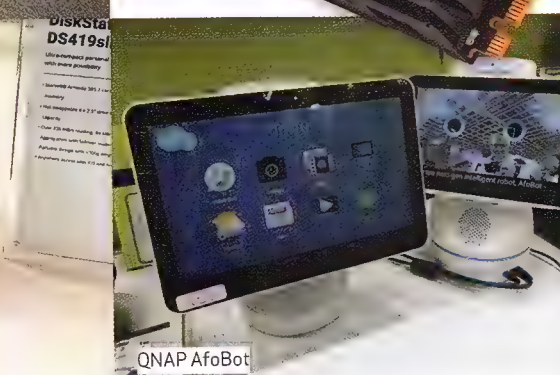
Aorus NVMe PCIe 4.0 SSD



Corsair's incredibly fast PCIe 4.0 MP600 SSD



Synology DS419slim



QNAP AfoBot

Mini-LED is an exciting new display technology, it competes with OLED but doesn't suffer from drawbacks such as static screen burn. The Asus ROG Swift PG27UQX boasts a 4K UHD resolution, 144Hz refresh rate, HDR 1000 support and is simply stunning, if not ideally demonstrated with the purple lighting in the ROG booth. We look forward to giving this one a thorough review.

Gigabyte announced it's making a big push into the gaming monitor market with its Aorus Tactical screens. The line-up features impressive software support, which allows users to adjust all monitor settings on the fly with their mouse or keyboard with incredible ease.

MSI wowed us with its 34-inch Prestige PS341WU monitor. It features a 5,120 x 2,160 ultrawide resolution, 98% DCI-P3 color gamut and 100% sRGB coverage. It's aimed at users who require maximum colour accuracy. It can also integrate with MSI's Prestige software suite for things like sharing colour profiles between users, something that's essential to creative teams.

Acer's CP7271K is an interesting monitor that should appeal to gamers and professionals alike. It's a 27-inch 4K display with 99% Adobe RGB colour gamut and HDR 1000 support. It comes with a 144Hz refresh rate and supports G-Sync Ultimate. As an all-rounder, this one looks pretty amazing.

STORAGE

One of the big talking points this year was PCI Express 4.0 and the upcoming NVMe SSDs that support it. We saw the CEO of Phison, one of the third-party controller manufacturers, make some bullish statements at the Aorus press conference. All the PCIe 4.0 based drives we saw across the show floor contained Phison controllers.

Gigabyte showed off its Aorus PCIe 4.0 NVMe SSD along with a 4 way PCIe 4.0 x16 add-in card that was demonstrated with sustained read and write speeds above 15GB/s. Fifteen Gigabytes per second. Wow. Gigabyte's Aorus standalone PCIe 4.0 SSD was shown with a very attractive and chunky copper heatsink. From what we heard, these drives run hot and need serious cooling to prevent thermal throttling.

Adata and Corsair showed off their PCIe 4.0 drives, so as we enter Q3 and Q4, we should have some good choices. No word from the big guns in the SSD space, Samsung and Western Digital, about their drives, though it's only a matter of time. Obviously Intel won't be going hard on PCIe 4.0 until their own motherboards support it.

We took the time to visit Synology's new Taipei headquarters and came away impressed with how the company continues to innovate and evolve its DSM NAS software.

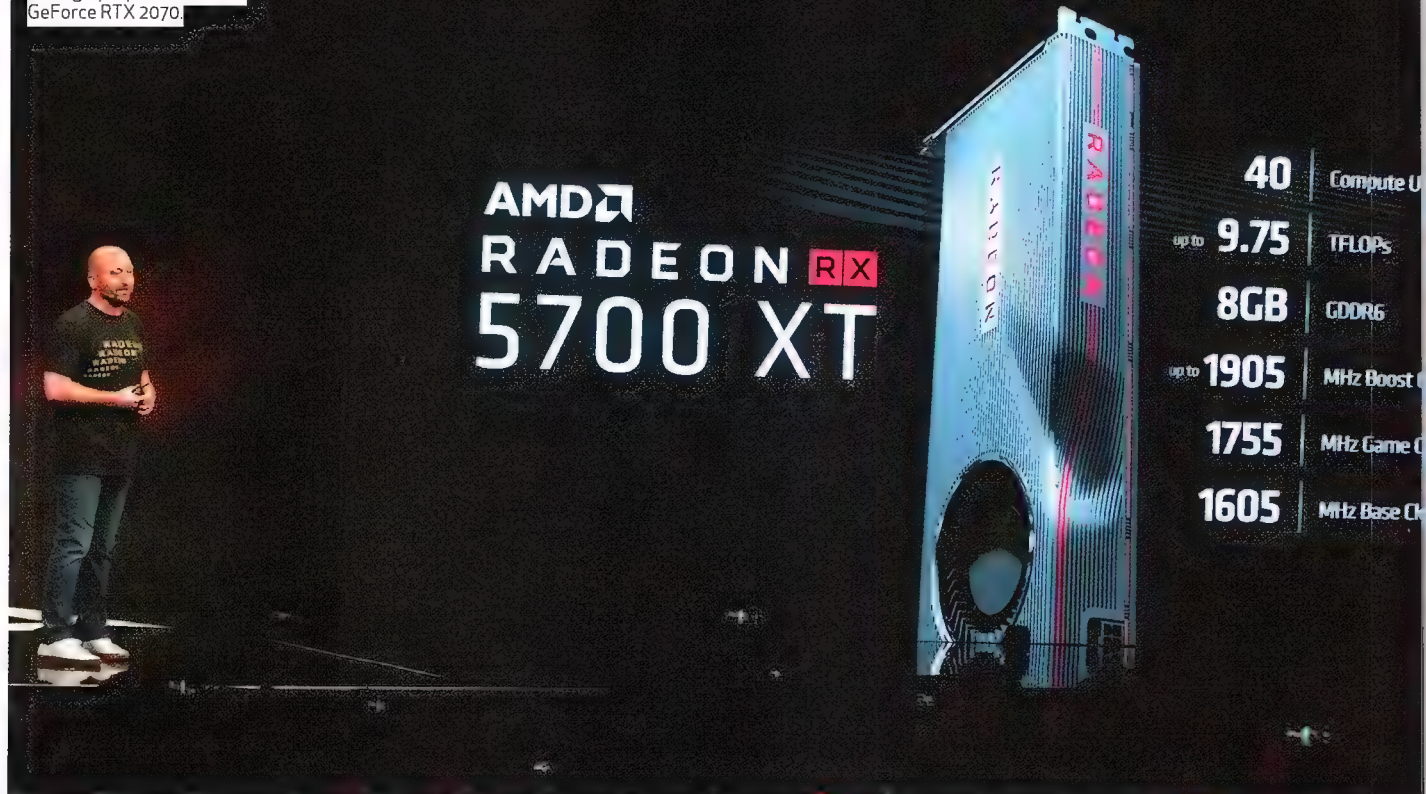
While there weren't a lot of new NASs shown, we were impressed by a couple of small form factor designs, the DS419slim and DS620slim. These small units can accept four and six 2.5-inch drives respectively and can still max out an aggregated dual Gigabit link at 220MB/s.

Over at QNAP, a new media NAS was debuted. The QNAP HS-453DX has a 1.5GHz Celeron processor to handle HD streams and can take a pair of M.2 SATA drives. We also saw a couple of very nice consumer-level switches offering 10GbE as well as 10/100/1000T ports. The QNAP QSW-308 is one of a new breed of ultra-fast home switches which could see good uptake as demand for faster connectivity grows.

We also saw a new Alexa screen system that replaces the more toyish looking QNAP AfoBot. This one is intended for home use as well as a virtual receptionist, or for remote medical care. ■

Our thanks to Panasonic for the loan of a Lumix LX100 II camera, which was used to take many of these photos.

Based on AMD's own numbers, the RX 5700 XT is roughly equal to Nvidia's GeForce RTX 2070.



The image shows a large, illuminated AMD Radeon RX 5700 XT graphics card standing vertically. To the left, a man in a dark t-shirt and jeans stands on a stage, providing a sense of scale. The background is dark with blue and white light effects. The AMD logo and 'RADEON RX 5700 XT' are prominently displayed in the center.

40	Compute U
up to 9.75	TFLOPs
8GB	GDDR6
up to 1905	MHz Boost C
1755	MHz Game C
1605	MHz Base C

AMD LAUNCHES NEW GPU FAMILY

CHRIS SZEWCZYK DIVES INTO AMD'S LONG AWAITED NEXT GENERATION GRAPHICS ARCHITECTURE.

While AMD has received many plaudits for its Ryzen CPUs in recent times, the company has been relatively quiet on the GPU front. We've been hoping AMD would have a 'Ryzen GPU' moment with its long awaited new Navi range of graphics cards. So has that moment arrived? We'll have to wait until we've got review samples in hand to know for sure, though it does indeed look like AMD has a solid foundation from which to launch an attack on the mainstream gaming GPU market. AMD's CEO Dr Lisa Su revealed the first Navi details at a keynote at Computex, followed by a series of technical briefings held in Los Angeles, culminating in a keynote at E3. We were present at all of these events, and there was a definite sense of optimism coming from AMD staff. Here's what we know.

MEET RDNA & THE RADEON RX 5700 SERIES

The base architecture at the heart of Navi is called Radeon DNA (aka RDNA).

It replaces the profitable but ageing GCN architecture that forms the basis of all recent AMD GPUs. GCN faced problems with energy efficiency and clock scaling, both of which are areas AMD needed to dramatically improve. These issues, and their remedies, lie at the heart of RDNA-based cards that will appear over the next several years.

The first cards to come to market are the Radeon RX 5700, RX 5700 XT and also a special 50th Anniversary RX 5700 XT. The cards go on-sale on July 7th, 2019. All three GPUs in the Radeon RX 5700 family are built using TSMC's 7nm process. The 5700 die size is 251mm² which compares favourably from a manufacturing standpoint to the 445mm² 12nm TU106 die found in Nvidia's GeForce RTX 2060 and 2070.

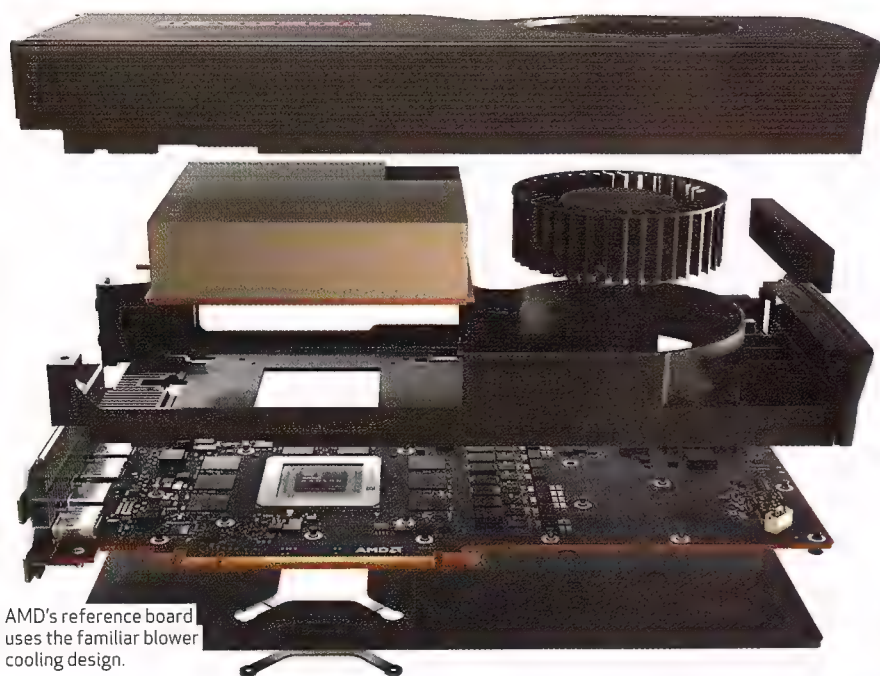
The specifications of the cards themselves give a glimpse of how RDNA and 7nm has helped AMD scale Navi clock speeds and improve power efficiency compared to the likes of the Vega 64. A rated boost-clock of up to

1905MHz for the 5700 XT and 1725MHz for the 5700 at 225W and 180W would simply not be possible with Vega. Even the power-guzzling 7nm Radeon VII couldn't clock that high. Both cards feature GDDR6 memory, PCI Express 4.0, and support HDMI 2.0b and DisplayPort 1.4 with Freesync 2 and Display Stream Compression, which allows up to 8K at 60Hz with HDR over a single cable.

Navi isn't all about the 5700 series. Arguably, the really big news out of Computex and E3 was the reveal that Navi will find its way into the next PlayStation and Xbox consoles. This means game developers will be up close and personal with RDNA for many years to come.

A LOOK UNDER THE HOOD

An all new multilevel cache hierarchy reduces latency and allows for greater bandwidth and a reduction in power draw. A new L1 and L2 cache reduces congestion leading to a claimed 24% reduction in latency. Combine this with



AMD's reference board uses the familiar blower cooling design.



Is this AMD's winning weapon in the fight against Nvidia?

AMD's CEO Dr Lisa Su shows off the RX 5700.

instruction cache and memory latency improvements and it becomes clear that Navi has reduced some of the bottlenecks it needed to.

A redesigned graphics pipeline leads to improved efficiency and higher clock speeds. Reduced logic complexity, optimised clock gating and 7nm technology all contribute to power efficiency and improved frequencies. All of this (and many more deep level tweaks) means that RDNA based Navi GPUs offer 1.25x performance-per-clock and 1.5x performance-per-watt compared to GCN.

All of this is impressive, but it doesn't mean a lot unless we know how Navi performs. We'll wait to pass final judgement until we perform our own testing, however, AMD was not shy in claiming that the 5700 XT is overall faster than the RTX 2070 in a 'best vs best API' test at 1440p with max settings across 10 AAA games.

The 5700 has an even bigger average lead over the RTX 2060 according to AMD, leading in every one of the 10 tested games. At the time of writing, the Australian prices of both the 5700 and 5700 XT were still to be determined, so we only have confirmed USD pricing. The Radeon RX 5700 has an RRP of US\$379, making it more expensive than the RTX 2060. The 2700 XT comes in at US\$449, which is well placed to compete with the US\$499 GeForce RTX 2070. The 50th Anniversary Edition lands at US\$549. These prices are higher than we'd have liked, but we can't talk about value until we've tested them ourselves.

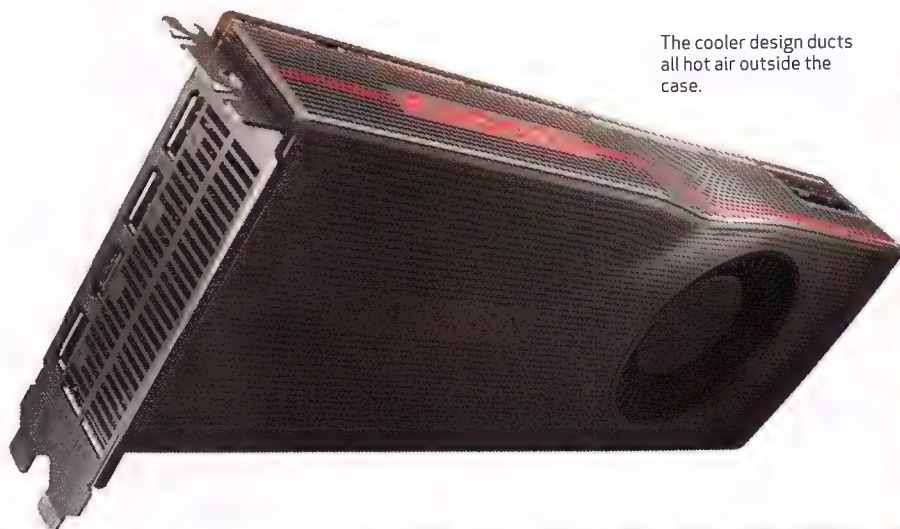
LAYING THE FOUNDATIONS

Now, let's speculate a bit about what we didn't see. Will we see a big Navi GPU to take on the likes of the RTX 2080 Ti? We think it will happen eventually, but probably not until Nvidia itself moves to 7nm. There's clearly the available power budget for it, as well as the possibility of scaling up the shader count significantly with a larger die. AMD gave us a smirk and a "no comment" when we asked directly, but one senior AMD graphics engineer we spoke to noted that he was excited about 2020.

What about ray-tracing? Nvidia has bet the house on it, while AMD is more cautious, adopting a wait-and-see approach. AMD believes it's too early to devote significant resources towards ray tracing, which is still essentially

eye candy and not a truly viable rendering technique. Having said that, given the long life of the next console generation of a decade or more from today, we think it's likely that console Navi GPUs will support some sort of ray tracing in hardware. Understandably, AMD didn't want to discuss its custom GPUs so far out from their launch.

In summary, we noted that AMD was squarely positioning RDNA as the foundation of its GPU strategy for many years to come. It has a well-defined internal roadmap, it's well-funded thanks to the overall financial performance of the company in recent years and AMD seems very confident in Radeon going forward. The GPU business never stands still. We look forward to seeing what the future holds for RDNA. We'll have full reviews of both the RX 5700 and RX 5700 XT in the next issue. Stay tuned! ■



The cooler design ducts all hot air outside the case.

Filter by title

Windows 10 release information
Message center

▾ Version 1903

Known issues and notifications
Resolved issues

▸ Version 1809 and Windows Server 2019

▸ Version 1803

▸ Version 1709

▸ Version 1703

▸ Version 1607 and Windows Server 2016

▸ Version 1507

▸ Previous versions

Windows 10, version 1903 and Windows Server, version 1903

Find information on known issues for Windows 10, version 1903 and Windows Server, version 1903. Looking for a specific issue? Press CTRL + F (or Command + F if you are using a Mac) and enter your search term(s).

Current status as of June 6, 2019:

Windows 10, version 1903 is available for any user who manually selects "Check for updates" via Windows Update. The recommended servicing status is Semi-Annual Channel.

Note follow @WindowsUpdate to find out when new content is published to the release information dashboard.



Windows 10, version 1903
rollout begins
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IT pros in Windows 10
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Check Microsoft's list of known
Windows 10 May 2019 Update issues.

[See all messages >](#)

Windows 10 May 2019 Update problems, and how to fix them

Experiencing issues? You're not alone, and we know how to help.

The Windows 10 May 2019 Update started its rollout in May, and while Microsoft has gone to great lengths to try to make sure that this latest major update to Windows 10 is not plagued by the same level of problems that the October 2018 Update suffered, there have been some Windows 10 May 2019 Update problems spotted already.

So, we've gathered up all the update problems and fixes right here, so you don't have to search the internet if your PC isn't behaving itself.

CHECK MICROSOFT'S LIST OF KNOWN WINDOWS 10 MAY 2019 UPDATE ISSUES

Unlike previous Windows 10 Updates, Microsoft has created a webpage (<https://docs.microsoft.com/en-us/windows/release-information/status-windows-10-1903>) where you can view current Windows 10 May 2019 problems, along with details on what it is doing to fix them.

Make sure you check the web page to see if the issue you are experiencing is known to Microsoft, and what steps you need to take to fix it.

All these issues should in theory be fixed by an automatic patch – KB4505057 – which you can find out more about here: <https://support.microsoft.com/en-gb/help/4505057/windows-10-update-kb4505057>

DISPLAY BRIGHTNESS MAY NOT RESPOND TO ADJUSTMENTS

Some Intel display drivers were incompatible with the Windows 10 May 2019 May Update, which means you could not change the brightness of your display.

AUDIO NOT WORKING WITH DOLBY ATMOS HEADPHONES AND HOME THEATER IN MAY 2019 UPDATE

A Windows 10 May 2019 Update that some people were experience meant that some Dolby Atmos sound systems did not work properly.

DUPLICATE FOLDERS AND DOCUMENTS SHOWING IN USER PROFILE DIRECTORY

An error in the May 2019 Update where if certain folders (e.g. Desktop, Documents, or Pictures folders) are redirected, an empty folder with that same name may be created.

AMD RAID DRIVER INCOMPATIBILITY

Installation process may stop when trying to install Windows 10 May 2019 Update on computers that run certain versions of AMD RAID drivers.

"Unlike previous Windows 10 Updates, Microsoft has created a webpage where you can view current Windows 10 May 2019 problems, along with details on what it is doing to fix them."

ERROR ATTEMPTING TO INSTALL WINDOWS 10 MAY 2019 UPDATE WITH EXTERNAL USB DEVICE OR MEMORY CARD ATTACHED

PCs with an external USB device or SD memory card attached may get error: "This PC can't be upgraded to Windows 10."

UNABLE TO DISCOVER OR CONNECT TO BLUETOOTH DEVICES IN WINDOWS 10 MAY 2019 UPDATE

Microsoft has identified compatibility issues with some versions of Realtek and Qualcomm Bluetooth radio drivers.

NIGHT LIGHT SETTINGS DO NOT APPLY IN SOME CASES

Microsoft has identified some scenarios where night light settings may stop working.

INTEL AUDIO DISPLAYS AN INTCDAUD.SYS NOTIFICATION

Microsoft and Intel have identified an issue with a range of Intel Display Audio device drivers that may result in battery drain.

CANNOT LAUNCH CAMERA APP IN WINDOWS 10 MAY 2019 UPDATE

Microsoft and Intel have identified an issue affecting Intel RealSense SR300 or Intel RealSense S200 camera apps.

INTERMITTENT LOSS OF WI-FI CONNECTIVITY

Some older devices may experience loss of Wi-Fi connectivity due to an outdated Qualcomm driver.

D3D APPLICATIONS AND GAMES MAY FAIL TO ENTER FULL-SCREEN MODE ON ROTATED DISPLAYS

Some Direct3D (D3D) applications and games may fail to enter full-screen mode on rotated displays.

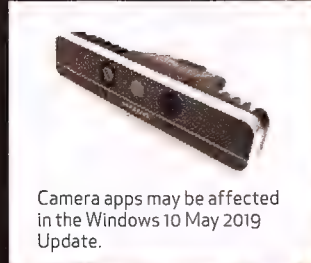
OLDER VERSIONS OF BATTLEYE ANTI-CHEAT SOFTWARE ARE INCOMPATIBLE WITH WINDOWS 10 MAY 2019 UPDATE

Microsoft and BattlEye have identified a compatibility issue with some games that use older versions of BattlEye anti-cheat software.

HOW TO FIX WINDOWS 10 MAY 2019 UPDATE INSTALLATION PROBLEMS

If you're encountering problems installing Windows 10 May 2019 Update via Windows 10's update tool, don't panic. Windows 10 has a built-in troubleshooter that can help identify any problems. This can also reset the Windows Update app, which can help kickstart the installation.

To do this, click the Start menu, then click the cog icon on the left, which will

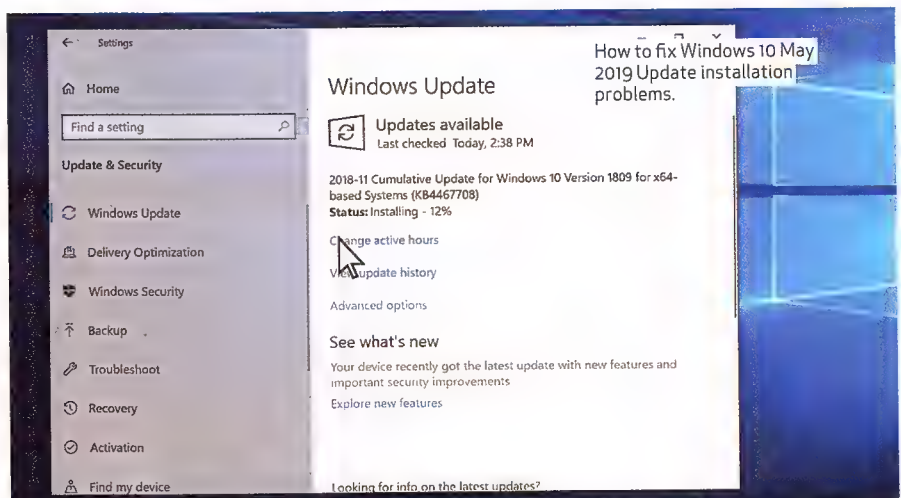


Camera apps may be affected in the Windows 10 May 2019 Update.



Bluetooth headphones could be affected by a couple of different problems.

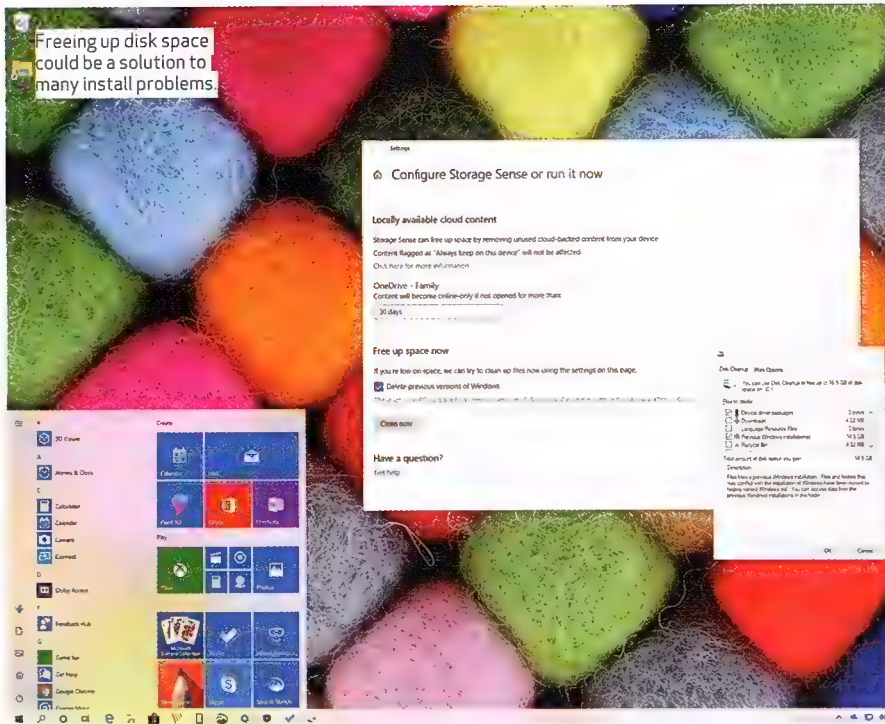
"If you have antivirus software installed, try disabling that before trying to install the update, as that may fix the problem. You should then enable it and use it normally once the installation has completed."



open up the Settings window. Click 'Update & Security' then 'Troubleshoot'. Click on 'Windows Update' then 'Run the troubleshooter' and follow the instructions, and click 'Apply this fix' if the troubleshooter finds a solution.

FREE UP DISK SPACE

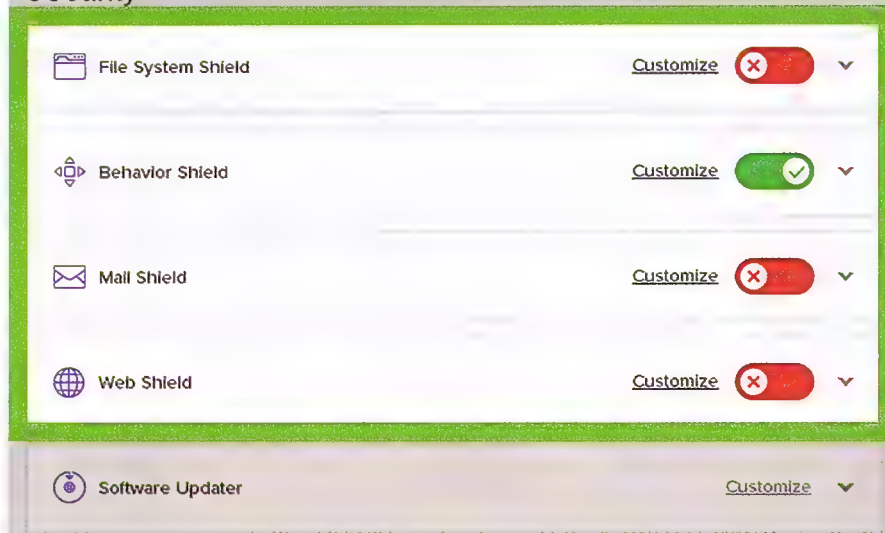
As with previous major updates for Windows 10, the May 2019 Update requires a certain amount of hard drive space to successfully download and install. If your main hard drive



Components

Disable anti-virus software for a cleaner update.

Security



(where Windows 10 is installed, usually the C: drive), is almost full, then you'll encounter problems when trying to install Windows 10 May 2019 Update.

The May 2019 Update requires 16GB of free space for the 32-bit version, while the 64-bit version needs 20GB on the hard drive where Windows 10 is installed.

So, the first thing you should do if the Windows 10 May 2019 Update install fails is to check your drive space in Windows Explorer. If it is running out of space, try typing in "Disk Clean-up" in the search box on the taskbar and select the system disk (usually the C: drive).

Click 'OK' then select the tick boxes of the files you want to delete. These should be safe to remove, but remember you can't retrieve them once they're gone. You'll be told how much space you'll save. Click 'OK' then 'Delete files' to remove the files. If you want to create more space, click 'Clean up system files'.

Once that's done, try downloading and installing the Windows 10 May 2019 Update again.

WINDOWS 10 MAY 2019 UPDATE INSTALL DISPLAYS 0X80190001, 0X80073712, OR 0X80245006 ERRORS

If you get an error message when

installing the Windows 10 May 2019 Update, and it displays a string of numbers like 0x80190001, 0x80073712, or 0x80245006 then it could mean that your PC needs more disk space.

To fix this problem, open Settings, go to System > Storage, then where it says 'Storage sense', click 'Free up space now'.

Select what you want to remove - and make sure 'Temporary Windows installation files' and 'Windows Setup temporary files' are both selected. Then click 'Remove files'.

Next, open up the Windows Update app and select 'Check for updates' to try installing it again.

DISABLE ANTI-VIRUS SOFTWARE

Antivirus software is certainly helpful to have, but it can sometimes cause problems when trying to install the Windows 10 May 2019 Update.

If you have antivirus software installed, try disabling that before trying to install the update, as that may fix the problem. You should then enable it and use it normally once the installation has completed.

You may even need to uninstall the software temporarily. Just make sure that you reinstall it once the update installs successfully.

RESET THE UPDATE

If you are still experiencing problems when trying to install the Windows 10 May 2019 Update, then you may need to reset the update service and try again.

To do this, open up the Command Prompt by typing in 'CMD' into the searchbar and right-clicking on 'Command Prompt'. Select 'Run as administrator'. Once open, type in the following, pressing Enter after each line:

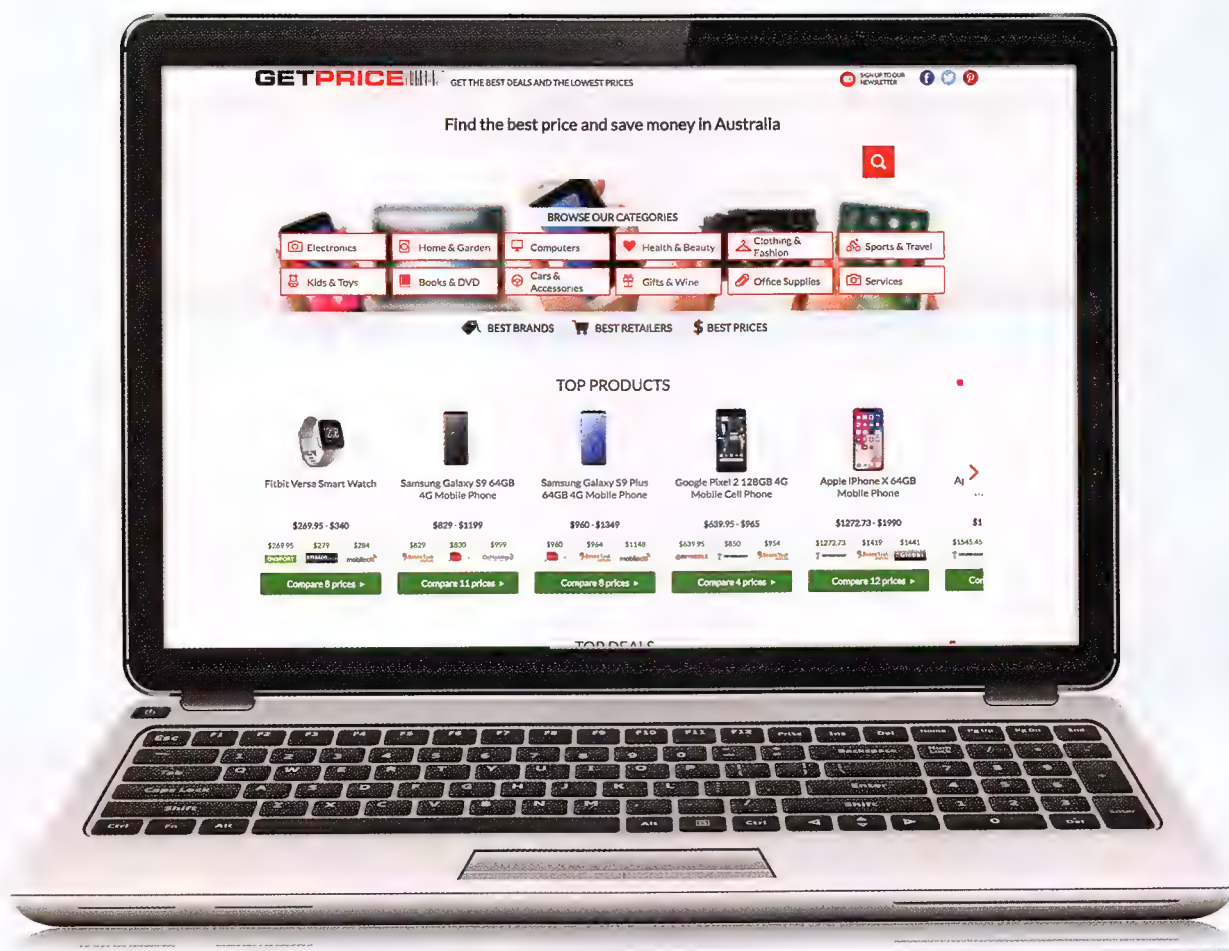
```
net stop wuauserv
net stop bits
net stop cryptsvc
Ren %systemroot%\
SoftwareDistribution\
SoftwareDistribution.bak
Ren %systemroot%\system32\
catroot2 catroot2.bak
net start wuauserv
net start bits
net start cryptsvc
```

Afterwards, restart your PC and try installing the May 2019 Update again.

UPDATE ASSISTANT GETS STUCK WHEN DOWNLOADING WINDOWS 10 MAY 2019 UPDATE

Here's how to fix the problem where the Update Assistant gets stuck and becomes unresponsive when downloading the Windows 10 May 2019 Update.

First of all, reboot your PC, then try



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running the Update Assistant again. If that doesn't work, either unplug your PC from the network physically, or disable the connection by typing in 'network adapter' into the search box in the taskbar.

Click 'Change network adapter options', and in the window that appears click 'Change adapter options'.

Right-click your network adapter, then select 'Disable'. This turns off the internet connection to your PC. Count to 20 seconds, then right-click it again and choose 'Enable'.

HOW TO FIX MAY 2019 UPDATE 0X800F0922 ERROR

If the Windows 10 May 2019 Update fails with an 0x800F0922 error, this may be because you have an active VPN connection that's interfering with Windows 10 contacting the update servers. To fix this issue, disconnect from the VPN server and try again.

If you don't know what a VPN (Virtual Private Network) is, then it means you probably don't have a connection.

This error can also occur if the System Reserved partition on your hard drive is full or not large enough. A third party disk cloning tool can

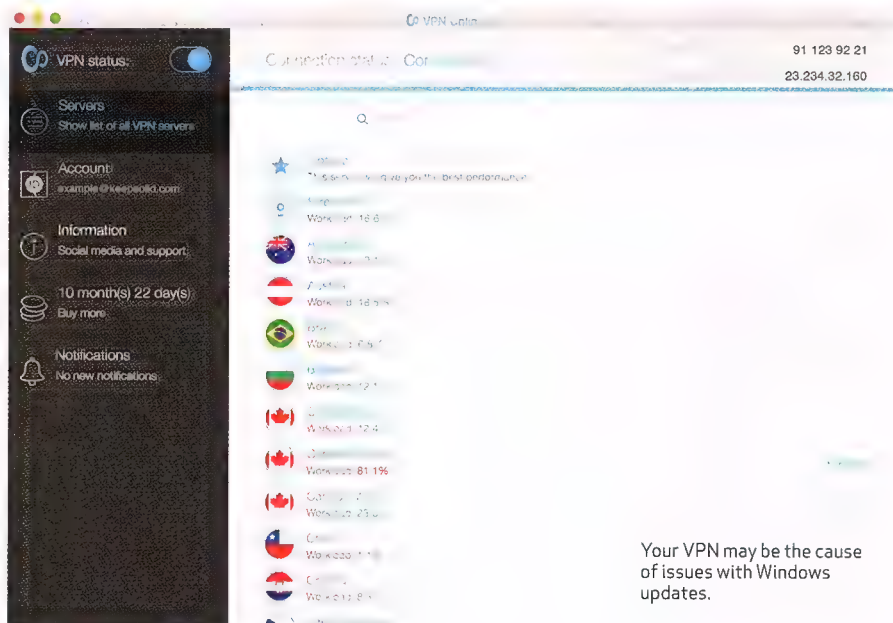
help you resize your partition.

HOW TO FIX WINDOWS 10 MAY 2019 UPDATE MEDIA CREATION TOOL PROBLEMS

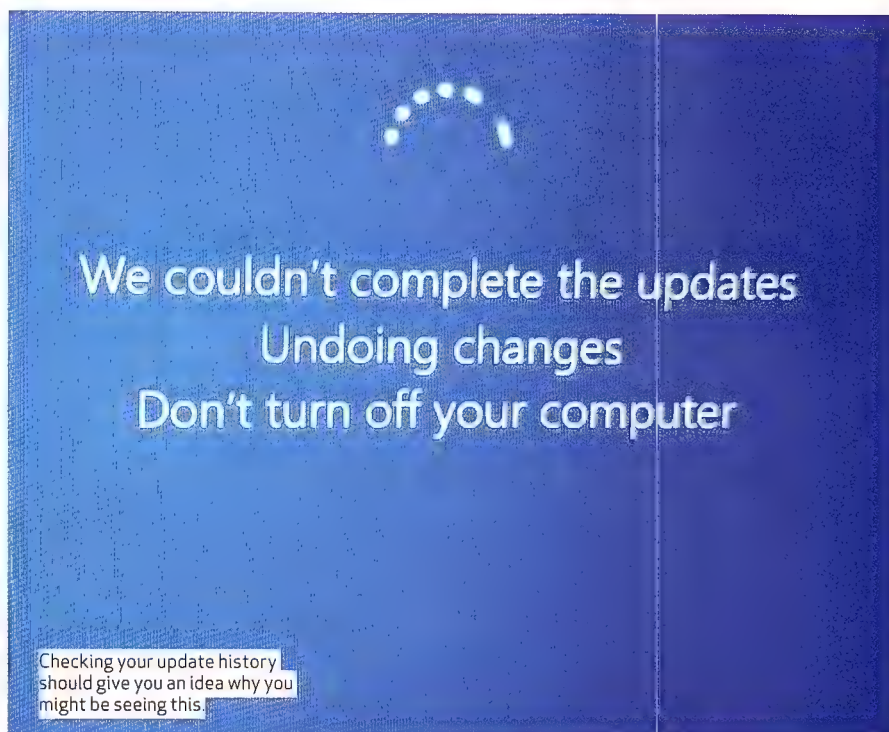
The Media Creation Tool is a handy app made by Microsoft that allows you to install the Windows 10 May 2019 Update using a USB drive or DVD. However, some people have

encountered problems when using it.

If the Media Creation Tool gets stuck when you're trying to download the Windows 10 May 2019 Update files, try closing and reopening the Media Creation Tool app. Once the app has downloaded the files, quickly disconnect your PC from the network (either remove the Ethernet cable or



Your VPN may be the cause of issues with Windows updates.



"Here's how to fix the problem where the Update Assistant gets stuck and becomes unresponsive when downloading the Windows 10 May 2019 Update. First of all, reboot your PC, then try running the Update Assistant again."

turn off your Wi-Fi adapter).

The installation should continue (without checking the internet for more files) and once it's complete you can reconnect to the internet. Finally, open up Windows Update (Settings > Update & Security > Windows Update) and click 'Check for Updates' to download the final files.

Some people are receiving a 'DynamicUpdate' error message when using the Media Creation Tool. To fix this, open File Explorer and go to C:\\$Windows-.WS\Sources\Windows\sources.

You should see an app called Setupprep.exe. Double-click it to launch the update program.

HOW TO FIX CORRUPTED ISO PROBLEMS WITH WINDOWS 10 MAY 2019 UPDATE

If you're trying to install the Windows 10 May 2019 Update using an ISO file, and you've encountered an error numbered 0x8007025D - 0x2000C, then this means that the

Windows 10 May 2019 Update might be corrupted.

If this happens, try downloading the ISO file again, then run the Media Creation Tool again to create a bootable USB or DVD and try again.

HOW TO FIX PROBLEMS THAT STOP WINDOWS 10 MAY 2019 UPDATE FROM FINISHING THE INSTALL

There's nothing more frustrating than seeing an update seemingly install without a problem, and then getting an error message at the last moment.

Some people are reporting that they're seeing 'Error: We couldn't complete the updates. Undoing changes. Don't turn off your computer' and 'Error: Failure configuring Windows Updates. Reverting changes' messages, which prevent Windows 10 May 2019 Update from finishing the install process.

You can check to see what went wrong by going to Settings > Update & Security > Windows Update and clicking 'Update history'. This should show you any problems that were

encountered. Make a note of these, then search the internet for a solution.

REPAIR YOUR HARD DRIVE IF WINDOWS 10 MAY 2019 UPDATE IS HAVING ISSUES

If Windows 10 May 2019 Update is struggling to install, you can check your hard drive for errors. To do this, you need to use the CHKDSK command in the command prompt.

Type "command prompt" into the search box in the taskbar, right-click "Command Prompt" and select "Run as administrator".

When it opens type in the following, then press Enter on your keyboard:

```
chkdsk /f c:
```

You may be asked to press Y or Enter on your keyboard to confirm the check. Allow it to run, and if any errors are found, follow the instructions to fix them.

HOW TO UNINSTALL WINDOWS 10 MAY 2019 UPDATE

If you're still encountering problems with the Windows 10 May 2019 Update, or you don't like the changes Microsoft has made, then you can uninstall the May 2019 Update and revert to a previous version of Windows.

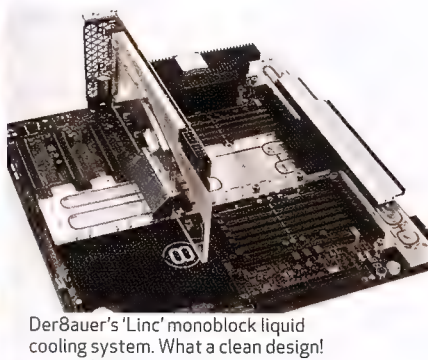
We wouldn't actually advise doing this, as you might miss out on future security updates from Microsoft, but if you would rather go back until all the bugs and problems with the Windows 10 May 2019 Update has been fixed, then follow these steps.

First, go to Settings > Update & security > Recovery and click on 'Get started' under where it says 'Go back to the previous version of Windows 10'.

A window will appear asking you why you want to revert to a previous version. Answer the question (this helps Microsoft improve future versions of Windows), then click 'No, thanks' from the next window. This is where it asks you if you want to check for any updates.

Click 'Next' on the window that follows, then 'Next' again, making sure you have your Windows log in details handy. Finally, click 'Go back to earlier build' and the Windows 10 May 2019 Update will uninstall.

If you wait 10 days to uninstall the Windows 10 May 2019 Update, you might find the option is gone. Unfortunately, the only way to uninstall the May 2019 Update after that is to perform a fresh install of Windows 10 using an ISO file of an older version. ■



System News

Computex! It's Mark Williams' favourite time of the year for new PC technologies and ideas.

Computex sure served up some great headline product announcements this year, most notably from AMD. But it was the nifty little things that caught my eye this year.

M.4

After all the strange and unique connector and format types that emerged early on in the development of SSDs, post-SATA it's the M.2 format that has won out as the main standard for consumer drives. Inherent in its design was the connector that only allowed for a 4x wide PCIe 3.0 bus at the end of a "gum stick" sized PCB.

The physical size of the M.2 PCB also constrained how much flash memory could be placed upon it. And with just a 4x PCIe bus electrically limiting bandwidth, NVMe drives have hit an inevitable bandwidth ceiling of 3500MB/s.

Silicon Motion was demonstrating a new M.4 SSD format made by Agylstor, which essentially takes two M.2s and fuses them physically together side-by-side, thus doubling the width of the drive as well as the PCIe connection. This allows for a doubling of not only capacity – with more space for flash dies – but also a doubling of bandwidth.

M.4 is aimed more at enterprise for now, and with new PCIe 4.0 SSDs about to flood the market, bandwidth isn't of concern again for the immediate future of M.2, but it's good to see there's an alternative should M.2 hit a brick wall down the track. You can read more about PCIe SSDs in our Computex feature starting on page 56.

BEST DUAL-SLOT AIR COOLER EVER?

One of the more unique things displayed at Computex this year was a

dual-PCI slot air cooling solution from Powercolor. Designed more for rack servers – where space is at a premium and where water cooling isn't possible for reliability and maintenance reasons – this unique product is an attempt at brute forcing the ultimate air-cooling solution.

It mates two high-static-pressure 250CFM fans with a funnel that tapers down into the thin dimensions of the dual slot card. Air chambers on each side channel the voluminous amounts of air being rammed across the thin heatsinks on the card. It's loud, it's bulky – but what an awesome solution to a unique problem!

MONOBLOCKS

Water cooling was a big thing this year, where we saw the movement of some big manufactures into the custom water loop sector, like Corsair with its Hydro X line-up of products. Whilst great to see, it was the emergence of so-called monoblocks that really drew much of the awe this year. Typically, water cooling loops use tubing to connect the disparate parts of the loop together, which if not planned out correctly can look messy and be a chore to put together.

Famous overclocker Der8auer was showing off his new "Linc" monoblock water cooling product, which cools the CPU, motherboard VRMs, network chipset, motherboard chipset and up to two graphics cards, all without any tubing whatsoever connecting them all together.

A supremely clean looking solution that is quite bespoke, at almost \$14,000 it's not for everyone but is a unique take on the concept of what a water block can be and do, and it would not surprise us one bit if this was picked up by a motherboard manufacturer.

SHOP TALK

What products/technologies caught your attention this year from Computex?

Jaimie, Leader Computers:

"The overwhelming theme this year that caught our attention is the Internet of Things (IoT) integration and AI.

IoT is finally starting to be implemented and is accelerating at an enormous rate. Shuttle, for example, have artificial intelligence-enabled advertising screens which use a high-performance camera to facially detect if you are male or female, then display different marketing material based on your gender. From there it gets interesting. The unit reports back to base a wealth of statistics to help the business market more effectively, how many males versus female customers stopped to look at the advertising, how long they spent reading the screen, which advertisement has the most eye interaction and engagement etc.

Technologies integrating both basic AI and reporting that data collected back using IoT connectivity will revolutionise the way we shop and seek entertainment over the coming decade."

John, TI Computers:

"The biggest highlight this year is no doubt the big comeback of AMD, taking back the leading position with its Zen 2 and RDNA architecture featuring PCIe 4.0. When you see major players such as Asus ROG extending its premium product lines to include AMD, such as the Formula and Impact series, you know this is going to be a success.

Apart from that, I am also very excited with new and upcoming display technologies. Things like 240Hz IPS displays on Asus' new ROG Strix Scar III and Hero III gaming notebooks and ELMB Sync on its TUF Gaming displays are definitely things I would like to check out and offer to my customers."

Market Snapshot

A sampling of PC systems available this month.



PC Case Gear Lancool 2060

\$1,799 TINYURL.COM/APC470PCC

If the Night King from *Game of Thrones* owned a computer, I reckon this is what it would look like. This cool build is well themed and lit, and packages together a reasonably powerful system for the price. It's capable of 1080p gaming with high details and refresh rates, even with some ray tracing if managed properly. The CPU will handle any modern game easily. No Hyper-Threading, overclocking or iGPU combined with the stock HSF will curtail what any enthusiast might want from a system, but if you just want a PC that works and don't want to play around with configuration options, this is a solid pick. A no-nonsense rig that looks the part.

KEY SPECS: CPU: Intel Core i5-9400F **COOLER:** OEM **MOTHERBOARD:** MSI B360M Gaming Plus **GRAPHICS:** MSI GeForce RTX 2060 Ventus XS OC 6GB **MEMORY:** Team T-Force Night Hawk RGB 3000MHz 16GB DDR4 **STORAGE:** Adata XPG SX8200 Pro 256GB SSD, Seagate Barracuda 2TB HDD **POWER SUPPLY:** Phanteks PH-P550GF 550W **CASE:** Lian Li Lancool One



Scorptec Master RTX 2070

\$1,949 TINYURL.COM/APC470SCO

Coming in at \$150 more than the Lancool 2060 system, this system is much better in some important areas. The big-ticket item in this system is the graphics card, pushing well into the performance market, this will easily handle 1440p gaming and 144Hz refresh rate targets. The CPU is arguably more fun for enthusiasts than the Lancool PC to the left, as this is unlocked, meaning overclocking is possible for some free extra performance. The rest of the system looks reasonable, specs wise, for the price point. A lack of 2933MHz-supporting memory will hurt the processor a little bit, as AMD's underlying Infinity Fabric technology likes the extra bandwidth for inter-core communications, but at this point we're just nitpicking. Great performance for the price.

KEY SPECS: CPU: AMD Ryzen 5 2600 **COOLER:** OEM **MOTHERBOARD:** MSI Bazooka B450M **GRAPHICS:** MSI Ventus GeForce RTX 2070 8GB **MEMORY:** Corsair Vengeance LPX 16GB 2666MHz DDR4 **STORAGE:** Samsung 970 EVO Plus 250GB M.2 SSD, Seagate BarraCuda 2TB HDD **POWER SUPPLY:** Corsair CX550M 550W **CASE:** Cooler Master MasterBox Lite 3.1 TG



PLE Computers Home Focus

\$846 TINYURL.COM/APC470PLE

This is perfect for a typical family computer system. It's cost-effective at well under \$1,000, with a good amount of storage included for all those family photos, videos or school projects. The processor is quite handy for typical everyday tasks and with decent integrated graphics it'll even let you run less-demanding game titles... after the homework is done of course! With a direct upgrade path to the new Ryzen 3000-series APUs, this system can be upgraded if the need arises later, however the 450W power supply will limit discrete graphics card upgrades unless the PSU gets upgraded as well. Funnily enough, it sports an optical drive. Remove it at checkout to save \$18.

KEY SPECS: CPU: AMD Ryzen 5 2400 **COOLER:** OEM **MOTHERBOARD:** Asus Prime A320M-E **GRAPHICS:** Onboard **MEMORY:** Geil 8GB DDR4 Pristine 2400MHz **STORAGE:** WD Green 240GB SSD, Seagate Barracuda 1TB HDD **POWER SUPPLY:** eVGA GD Series 450W **CASE:** Deepcool Wave V2

Mwave X690iR2G

\$4,399 - TINYURL.COM/APC470MWV

4K... ultra graphics settings... 144fps+... if these are the sort of things you're wanting from your gaming experience, then look no further. Sporting nothing but the best for gaming performance, this system has you covered from the top of the line graphics card to pump out the pretties through to one of Intel's best CPUs to keep it fed. Just be aware that being an 'F' CPU variant means no iGPU, and thus lack for QuickSync support, which is important for things like Adobe Premier.

Dual 500GB NVMe SSDs will keep your OS, apps and games snappy, with a 2TB HDD for mass media. With RGB all around, it will certainly look as good as it performs.

KEY SPECS: CPU: Intel Core i9-9900KF **COOLER:** Cooler Master MasterLiquid ML360R ARGB **MOTHERBOARD:** Asus Z390-E **GRAPHICS:** Asus ROG Strix GeForce RTX 2080 Ti **MEMORY:** T-Force Delta 2 DDR4 RGB 16GB 3200MHz **STORAGE:** 2x 500GB NVMe M.2 SSD, 2TB 7200RPM HDD **POWER SUPPLY:** Unspecified **CASE:** Cougar Gemini S RGB



PC blueprints

The APC team's picks for a part-by-part perfect PC build to suit your budget.



PARTS LIST

PART		PRICE
CASE	BITFENIX NOVA TG	\$75
PSU	450W EVGA 450 BR 80+ BRONZE NEW	\$49
MOTHERBOARD	ASROCK B450M R4.0 AM4	\$95
CPU	AMD RYZEN 5 2600	\$232
GPU	GIGABYTE GEFORCE GTX 1660 6GB	\$389
RAM	8GB (2X 4GB) PATRIOT VIPER 4 @ 3,000MHZ NEW	\$78
SSD	120GB CRUCIAL BX500 2.5-INCH SSD	\$29
HDD	1TB WD BLUE 3.5-INCH HDD	\$59
OS	UBUNTU DESKTOP LINUX 18.04 LTS 64-BIT	\$0
APPROXIMATE PRICE:		\$1,006

The only thing we saw fit to trade out this month was the power supply and the RAM, and these were only minor changes. Power-wise, there was no need to step above 450W, but despite PSU prices still sitting quite high, we were lucky enough to spy EVGA's 450 BR, trading out the previous Corsair PSU to save ourselves 15 dollars. Those aren't the only savings we made here, though; the price of the Ryzen 5 2600 processor has dropped by \$13, and the Crucial BX500 SSD has slightly dropped in price, saving us a crisp four dollars. Lastly, we managed to find cheaper memory than the T-Force kit that's stayed in this build for such a long time. Now it appears Patriot is the price leader, so we've dropped in an 8GB kit and saved \$31, though we have dropped ever so slightly in speed, from 3,200 to 3,000MHz, which we consider a reasonable tradeoff. It all adds up to a \$63 saving overall compared to last issue.



PARTS LIST

PART		PRICE
CASE	FRACTAL DESIGN MESHIFY C	\$149
PSU	550W CORSAIR CX550 80+ BRONZE NEW	\$75
MOTHERBOARD	ASUS ROG STRIX B450-F GAMING	\$209
CPU	AMD RYZEN 7 2700	\$359
COOLER	COOLER MASTER MASTERLIQUID LITE 240MM RGB AIO	\$89
GPU	ZOTAC GAMING GEFORCE RTX 2060 6GB	\$469
RAM	16GB (2X 8GB) BALLISTIX SPORT LT @ 3,200MHZ NEW	\$138
SSD	250GB SAMSUNG 970 EVO PLUS M.2 PCIE SSD	\$119
HDD	1TB WD BLUE 3.5-INCH HDD	\$59
OS	WINDOWS 10 HOME 64-BIT OEM	\$140
APPROXIMATE PRICE:		\$1,806

Our mid-range build is looking mighty fine this month. Still, with memory prices starting to move around we decided to trade out the Team T-Force kit to a new Sport LT RAM kit from Ballistix, saving us \$41. Zotac's 6GB GeForce RTX 2060 had fallen by a whopping \$100 so that right there is a component that's staying put. Finally, we swapped out the PSU; sticking with Corsair but going from a CX550M to a CX550 to save 24 dollars. This brings our savings this month to a very nice \$165!



UPGRADE OF THE MONTH

16GB (2x 8GB) Ballistix Sport LT
@ 3,200MHz

\$138, [HTTP://BALLISTIXGAMING.COM](http://ballistixgaming.com)

If you're planning – or even just considering – a gaming build right now, Ballistix should be one of your first ports of call when looking at memory, particularly if what you're after is a reasonably-priced 1080p or 1440p rig. The Sport LT series is a good example of what it offers; a decent variety of capacities with high-speed options available at sensible prices. The ability to snap up a higher frequency RAM kit for a similar price is something to keep an eye out for if you're repping Team Red; Ryzen CPUs benefit significantly from higher memory speed, meaning that a few hundred extra MHz translate neatly to a few extra percent in processor performance.

"The Nzxt Kraken X52 is more expensive than the Be Quiet! Dark Rock Pro it replaced, but handles heat from CPU-heavy processes better. With high-end processors, liquid cooling is often the way to go, and AIO coolers make that process easy."

These prices went all over the place this month. Seriously, go check out the last issue for proof. The 32GB 3,200MHz Team T-Force memory dropped by \$80 – a surprise, to be sure, but a welcome one. We have switched out the Asrock X399 Phantom Gaming 6 motherboard from last issue due to its scarcity, replacing it with the excellent Asus Prime X399-A.

Our Asus RTX 2080 held steady at just \$1,049 and is a top value component in this build. We were compelled to swap back to an AIO cooler after dabbling in air cooling for this build last month. The Nzxt Kraken X52 is more expensive than the Be Quiet! Dark Rock Pro it replaced, but handles heat from CPU-heavy processes better. With high-end processors, liquid cooling is often the way to go, and AIO coolers make that process easy.

Storage demanded no changes; last month's upgrade of the month, the 512GB Aorus RGB SSD, remains solid, and WD's HDD prices have stayed balanced. Overall, the price has fallen by an ever so slight \$10. ■

PARTS LIST

PART		PRICE
CASE	NZXT H700I	\$259
PSU	CORSAIR 750W RM750W GOLD	\$175
MOTHERBOARD	ASROCK X399 PHANTOM GAMING 6	\$285
CPU	AMD THREADRIPPER 2950X	\$1,399
COOLER	NZXT KRAKEN X52 240MM RGB AIO NEW	\$189
GPU	ASUS TURBO GEFORCE GEFORCE RTX 2080	\$1,049
RAM	32GB (2X 16GB) TEAM T-FORCE VULCAN @ 3,000MHZ	\$299
SSD	512GB GIGABYTE AORUS RGB M.2 NVME	\$180
HDD	2X 2TB WD BLUE 3.5-INCH HDD	\$170
OS	WINDOWS 10 HOME 64-BIT OEM	\$140

APPROXIMATE PRICE: \$4,145



The Media Mandate

We set out to build an affordable media centre as the perfect rig for your living room.

It's easy for us to forget sometimes that people use computers for more than just gaming, benchmarking, and editing magazines. And that, sometimes, people might even plug their computers into a screen other than a monitor. So, when we got our hands on Fractal Design's Node 202 case, we knew what we had to do: build a sleek, powerful but inexpensive media centre, designed to sit snugly beneath the television. The brief for this PC Builder masterclass was a little tricky, though – it needed to be a PC that didn't look like a PC. We needed a Mini-ITX motherboard, HDMI port, and a processor with onboard graphics. Oh, and to keep the price as low as possible, thank you very much.

Media centre PCs are nothing new, but the components that can be used to make them are continually evolving – albeit at a slower rate than parts for beefy gaming PCs.

There's little to no precedent to fit a GPU inside one of these dinky rigs, and as more processors with onboard graphics are released, so expands our selection of potential builds. The "perfect" media centre build may not exist; indeed, builds like this are already competing with home consoles and high-end smart TVs. It's complicated, heavily populated ground. The advantage of these computers is the advanced degree of customisation and flexibility – unlike consoles and smart TVs, they have access to different operating systems, a wider selection of software, and can use internet browsers in a way that doesn't make you want to cut your hands off. They might not be as suitable for gaming as consoles, thanks to the lack of a dedicated graphics card, but they have the added bonus of easier repairs and upgrades – no waiting for the next console generation here; if you want to upgrade your processor, you can just go right out and do it.

"Media centre PCs are nothing new, but the components that can be used to make them are continually evolving."

LESS IS MORE

Fractal Design has knocked it out of the park again with the Node 202. The Swedish manufacturer has long been the top dog in case design, and this is no exception. The 202 serves as the basis for this build; simple but elegant, carefully designed to inhabit any space without being obtrusive. In appearance, it blurs the lines between PC and console, making it perfect for a media centre build. It's tiny, though; a thin little unit that demands care and minimalism when it comes to internal components. There's no need to include a GPU in this build, but the 202 comes with a little box of accessories that accommodate such power; most importantly, this box contains an L-shaped adapter that allows for vertical mounting of the GPU – a necessity, given the case's small overhead. The case as a whole can be oriented horizontally or vertically, with either a plastic base to mount it upright, or stick-on rubber feet.

And minimalism is what we've got. Asus's ROG Strix X470-I motherboard is a simplistic affair, but it packs everything we need: an HDMI output, four USB 3.1 ports, AM4 compatibility, and full support for all the RAM. It's an adorable unit, too – measuring a dainty 17 x 17cm, with a stripped-back appearance that doesn't sacrifice performance for aesthetics. It's the perfect board to support the AMD Athlon 220GE (available through [amazon.com.au](https://www.amazon.com.au)), which comes with integrated Radeon Vega 3 graphics, and its own cooler inside the box – a low-profile HSF that easily fits inside the Node 202.

There's not much else that needs including here – the 202 comes with an integrated 450W power supply, and we're forgoing a GPU in favor of the Athlon 220GE's own processor graphics. For the SSD, we've got a SATA Adata Ultimate SU800 with 128GB of storage – there's no space for a hard drive inside this case, and an M.2 drive would increase the price too much.

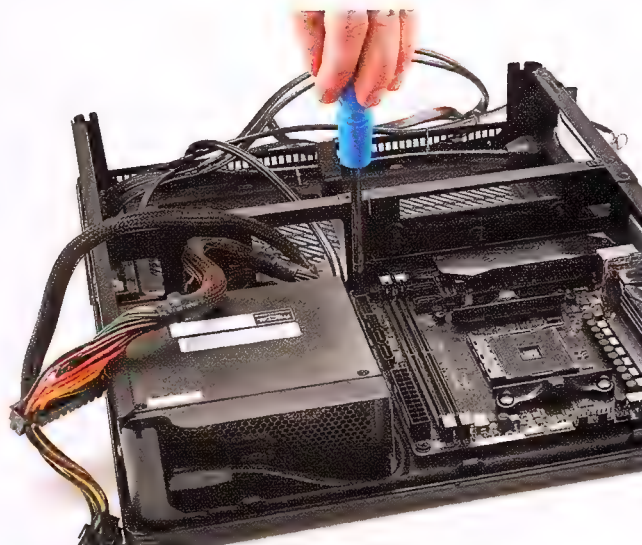


1 THE BARE NECESSITIES

As always, we start with a stripdown of the case. Lay it on its side and remove the four case screws, then flip the case over, and remove the large plastic side. The Node 202 comes with an integrated PSU, which feeds through to a standard three-pin power port in the opposite corner of the case. You can remove the PSU if you like, but you'll struggle to find another that fits for a sensible price. There aren't any case fans to worry about, but the cabling is all bundled together, so free that up first. Fractal Design knows how to do cable management; there are numerous slots for cable ties inside this case. If you want to install fans, this case has the capacity for two 120mm fans in the GPU chamber – but these are complicated to mount, and for us, the PSU and CPU fans suffice. You may also want to remove the SATA drive bracket next to the PSU, as you'll need it later.

PARTS LIST

PART		STREET PRICE
CASE	FRACTAL DESIGN NODE 202	\$229
MOTHERBOARD	ASUS ROG STRIX X470-I GAMING	\$319
CPU	AMD ATHLON 220GE	\$110
CPU COOLER	STOCK	N/A
MEMORY	CORSAIR VENGEANCE LPX 2X 4GB 2,400MHZ	\$79
PSU	450W FRACTAL DESIGN INTEGRA SFX	N/A
STORAGE	ADATA ULTIMATE SU800 128GB	\$39
OS	WINDOWS 10 HOME 64-BIT	\$140
TOTAL		\$916



2 BOARD MEETING

Ordinarily, we advise installing some components on the motherboard before sliding it inside the case, but not today – the overhead inside the 202 isn't exactly spacious, and the power cables can get in the way. Pop in the rear I/O shield, then lower the motherboard into place; this might require some finger gymnastics to keep the PSU cables out of the way. The motherboard screws down at four points, and the screws come in the 202's accessories box. Plug in the two motherboard power cables, feeding the eight-pin CPU power connector around the edge of the motherboard chamber, while the ATX cable can plug in directly. Fold the remaining cables into the space between the PSU and the metal plate that divides the case in two, and secure them with a cable tie – leave the SATA power cable free for now. The cables from the front I/O can be plugged in, feeding any excess length into the GPU cavity.



3 HAPPY MEMORIES

Time to install some components on the motherboard. The CPU can go in first – the Athlon 220GE drops neatly into the AM4 dock, and locks into place when the clasp is lowered. We'll install the cooler later, as it's the bulkiest component. For now, release the clasps on the memory slots, and install the RAM. You might need to shift the ATX power cable out of the way; the 202 is undeniably cramped inside. Push down the sticks until they click into place, then tidy up the cables as much as you can. This memory isn't the cheapest option available, but with low CAS latency and 3,200MHz, it's speedy and effective. If you want to install a GPU, do it now; plug in the L-shaped adapter and extender from the 202's box, then remove the rear I/O covers, and plug in the card.



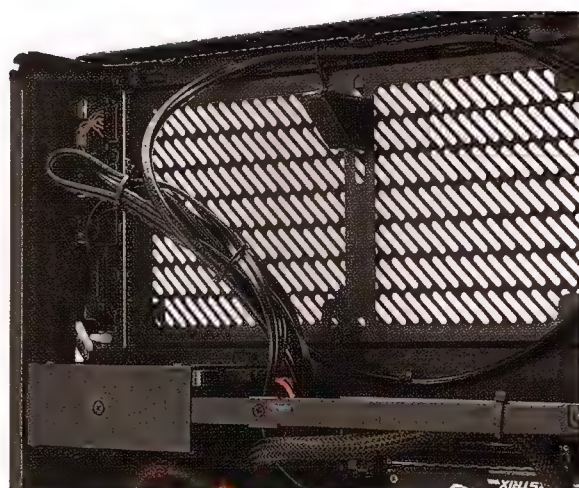
4 BRACKETEERING

This next step can be a tad tricky. Take the SATA drive bracket and screw in the SSD on the inner side, ensuring that it's aligned correctly. When the bracket is returned to the case, the drive needs to be on the opposite side of the divider to the PSU, pointing toward the motherboard. Once you're sure it's in the correct position, feed through the power and SATA cables from the PSU and motherboard respectively, and plug them in before slotting the bracket back into place and screwing it down. It's easiest to rest the bracket on the divider before screwing it back into place, so you can be certain the cables will stretch. If you have a short SATA cable to hand, we'd recommend using it. Keeping the total cable length inside this case to a minimum is a good plan.



5 STOCK AND LOAD

Everything else in place, it's time to install the CPU cooler. We're using the stock Athlon cooler, which isn't particularly exciting, but will fit directly on to the bracket that comes fitted on the Strix X470-I Gaming. Be careful when removing this cooler from the box – it comes with a neat little lattice of thermal paste already applied to the base of the heatsink, so take care not to get any on your fingers. This might not look like a lot, but it'll spread out evenly once the processor heats up, so there's no need to apply any extra paste. Place the cooler in the center of the CPU, then align the bracket so that it attaches to the motherboard on both sides, before turning the plastic handle to clamp it down. Once it's in place, plug it into the CPU fan connector on the motherboard.



6 TIDYING UP

This build might be finished, but we're not done yet. Reassembling the 202 isn't as simple as we'd like – no pop-off side panels or thumbscrews here, sadly. Before we seal the case up, it's worth taking time to arrange your cables; the front I/O wires can be neatly bundled with a cable tie, and any loose cables should be tucked away where possible. In theory, this build shouldn't need updating for a long time, so ensuring it's tidy inside is a must. Once you're satisfied, lower the plastic cover back on to the case, turn it over – carefully! – and screw it on. If you want to mount it upright, you're done; place it on the plastic mount, and it's ready to plug in and use. If you'd prefer to lie it flat, cut out the rubber feet, and peel off the sticky backs to secure them on the bottom of the case.



1 There's ample space for a GPU here, should you decide you'd like to do some proper couch gaming on this rig. It's a fairly complicated procedure, however, requiring the removal of the other side of the case and the adjustment of a support peg to fit the exact size of the card you use.

2 The aptly-named Integra SFX PSU pumps out all the power that a small build like this needs.

3 The Athlon 220GE's integrated graphics can handle standard online browsing and streaming perfectly well at an affordable price. The stock cooler does a decent job of keeping the temperature down, too.

Media madness

Well, this certainly isn't a gaming PC. Can it run games? Just about, but it barely made it through our regular benchmarks, which use ultra settings at 1080p. Dialing all the graphical settings down to minimum in *Rise of the Tomb Raider* and running it in 720p resulted in a more workable frame rate, but the game looked eerily reminiscent of *Runescape* circa 2003. That's all right, though – this wasn't designed to be a gaming computer. As a media centre, it does the job perfectly, running quietly and loading fast.

The Node 202 looks great, but it isn't easy to work in. It's packed with nice

features and innovations from Fractal Design, such as the perpendicular GPU mounting system and the SSD shroud, but they don't make it any simpler to build with it. Cable management is easier than in some other Mini-ITX cases, at least. Our finished build looks efficient and tidy inside, with the minimal RGB effects on the motherboard mostly concealed by the 202's black plastic exterior.

If we hadn't wanted to keep the price down, we'd have considered installing a GPU. Swapping out the CPU for something with a bit more muscle, and adding a GTX 1060 or 1070 would make

this a perfectly capable rig for gaming – perhaps a family-oriented console replacement, perfect for multiplayer sessions in front of the TV. Streaming TV and movies is a snap, and the SSD has sufficient storage for a reasonable number of video files, should downloading be your preferred method. A keyboard with an integrated trackpad or a wireless controller might be useful, to ensure ease of use from your favorite armchair.

There are some other things we might change, if we had a chance at a do-over. MSI, Gigabyte, and Asrock all offer cheaper Mini-ITX boards, so if gaming is fully off the table, the extra functionality of the X470-I isn't necessary. Our choice of motherboard also offers dual M.2 slots, which wasn't needed for this build – an M.2 SSD would have been easier to install than the SATA drive we chose, but it would have driven the price up.

If you're a real glutton for punishment, there's arguably no need to install Windows. A Linux-based OS is cheaper, although it would involve far more software wrangling. There are still plenty of useful media centre programs that can run on Linux, such as home cinema app Kodi. Chrome is available for 64-bit versions of Ubuntu, too. Overall, this build was a modest success – it looks good and it does the job we wanted it to – but there's definitely room for improvement. ■

BENCHMARK RESULTS

	ZERO-POINT	THIS SYSTEM
CINEBENCH R15 MULTI (INDEX)	541	373 (-31%)
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)	540	556 (3%)
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)	372	520 (40%)
RISE OF THE TOMB RAIDER (FPS)	5	7 (40%)
TOTAL WAR: WARHAMMER II (FPS)	3	4 (33%)
TOM CLANCY'S GHOST RECON WILDLANDS (FPS)	2	N/A
3DMARK: FIRE STRIKE (INDEX)	1,183	1,304 (10%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point consists of an Intel Core i3-8100, 8GB of Team Vulcan DDR4 @ 2,400, and a 120GB Kingston SSDNow UV400. All tests were performed at 1080p on the highest graphical profile.

howto

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

SOFTWARE

UNABLE TO TRANSCRIBE AUDIO RECORDING

I recently interviewed a family member for my genealogical research, but when I came to write up the transcription using Express Scribe (www.nch.com.au/scribe/) it says I need a pro licence because the audio files have been recorded in M4A format. Can I avoid this unnecessary expense?

Anna Young

What you need to do is find a tool that can convert the M4A file into one supported by the free version of the program, such as MP3. We recommend Pazera Free Audio Extractor (www.pazera-software.com/products/audio-extractor/), which not only supports a wide range of audio files, but can also be used to extract audio from video too. Download and run the portable version, then simply open the folder containing your audio files in File Explorer and drag them into the main program window. Use the options in the right-hand pane to choose your output directory, then select MP3 as the output format under Audio and finally click the Convert button. Once done, you should be able to load the MP3 files into Express Scribe without being prompted to pay for the professional version.

Ian Sleightholm

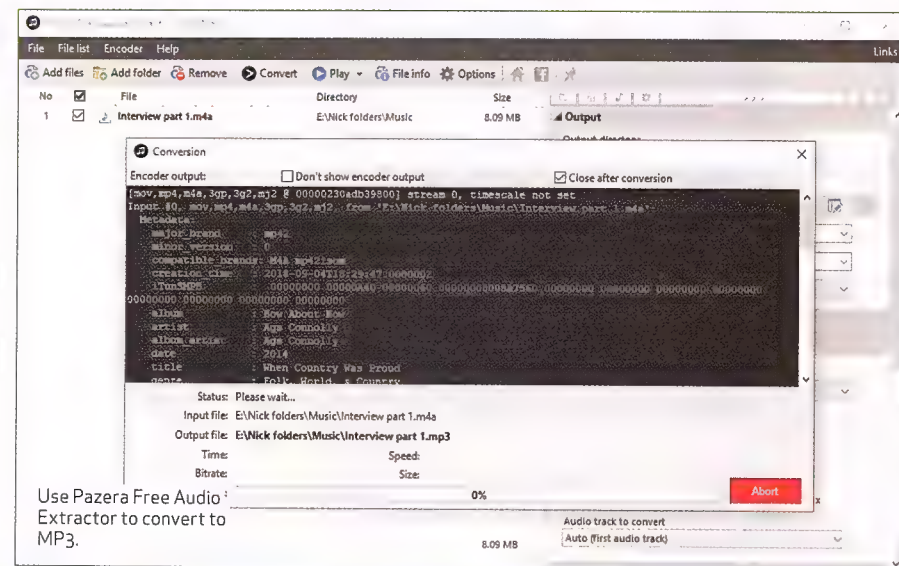
WINDOWS

GIVE BACK CONTROL OF ZIP FILES TO WINDOWS

Thanks to not being careful, I've inadvertently transferred control of ZIP files to another program. How do I restore the default settings back to Windows?

Max Stewart

Ordinarily you'd right-click a ZIP file, choose 'Open with > Choose another app', select File Explorer and make sure 'Always use this app to open .zip files' is ticked before clicking OK. But that option didn't appear for Max and attempting to manually select C:\Windows\explorer.exe



"What you need to do is find a tool that can convert the M4A file into one supported by the free version of the program, such as MP3."

failed too. Neither did Settings > Apps > 'Default apps' work – either by clicking Reset or by exploring the 'Set defaults by app' or 'Choose default applications by file type' options. This indicates there's some Registry corruption to deal with. The simplest way to fix this is to download a file that will repair the damaged components in the Registry – go to www.tenforums.com/tutorials/8703-restore.html, scroll down and click the ZIP option at the bottom to save zip.reg to your computer. Once that's done, double-click the file and click OK followed by Run to recreate the default settings. The fix should be applied immediately; if the file icon still isn't correct, try right-clicking the file and choosing 'Open with' > 'Choose another app' – you should see File Explorer is now the default option, so tick the 'Always use...' box

and this should fix the icon problem, too.

Nick Peers

HARDWARE

BEST WAY TO ACCESS DVDS ON MY 2-IN-1

I'd like to watch DVDs on my Windows 2-in-1 device, but of course it has no optical drive. What are my options? Gill Field

Portable external DVD drives are the obvious go-to solution, but if you go down this route check your 2-in-1 device has enough USB ports spare to accommodate it – some models can be powered from a single USB port, but many require two ports (one for data, the other for power). Another option if you're at home is to make use of your main PC's DVD drive by sharing it over the network. Open File Explorer, right-click the

drive and choose 'Give access to' > Advanced Sharing. Click 'Advanced Sharing...' again, tick 'Share this folder', then change the share name from the default (the drive) letter to something more descriptive, such as PC-DVD, and click OK. One final option is to generate ISO files from your DVDs on your main PC – for data discs, a tool like InfraRecorder (<http://infraRecorder.org/>) is perfect, but for video DVDs you'll need something like DVDFab Passkey Lite (www.dvdfab.cn/passkey-lite.htm). If your primary aim is to watch movies, perhaps now is the time to explore building your own media library using a tool like Emby (<https://emby.media>) or Plex (<https://plex.tv>), which can then be streamed to your tablet without taking up any precious storage space.

Mayank Sharma

HARDWARE

TRANSFER FILES FROM PHONE VIA BLUETOOTH

My Android phone's USB port has broken, so before its battery dies, how can I transfer key files from it to my PC? Harriet Gregg

While you could try a third-party program, we'd recommend using your PC's integrated Bluetooth connectivity if it has it.

Switch on Bluetooth on both your PC and your phone. Make sure that your phone is in discoverable mode by navigating to Settings > Bluetooth. On your PC navigate to Start > Settings > Devices > Bluetooth & other devices'. Verify that Bluetooth is switched on and your PC is discoverable. Click 'Add Bluetooth or other device', select Bluetooth and your phone or tablet should appear in the list. Click it to select it and wait for the initial connection to be made. When a PIN number appears, check that it's mirrored on the phone. Click 'Connect' on your PC, then click Pair on the phone. Wait for the connection to complete, then verify your PC is listed on the phone and the phone on your PC.

Scroll up to the 'Bluetooth & other devices' Settings page and click 'Send or receive files via Bluetooth'. Opt to receive files, then locate the files on your phone, tap the Share option and choose 'Send via Bluetooth' to send the files across.

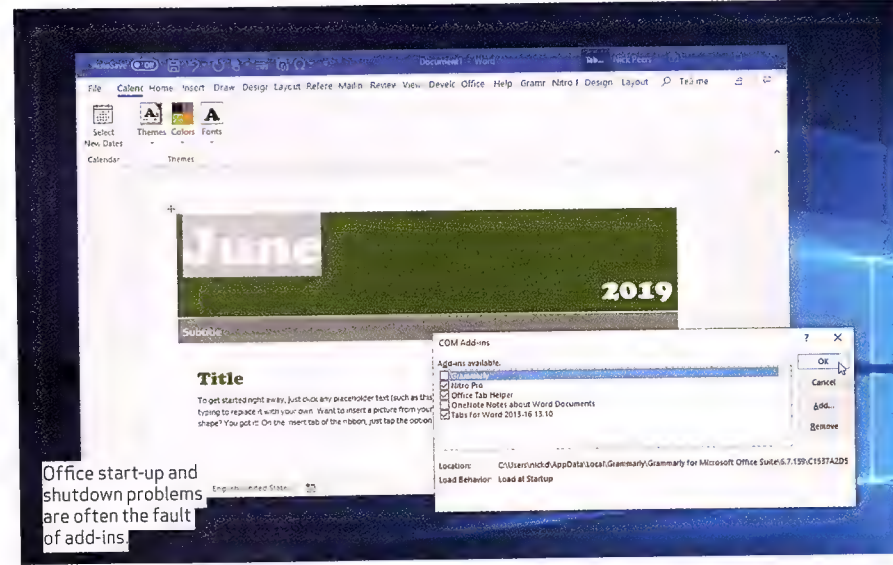
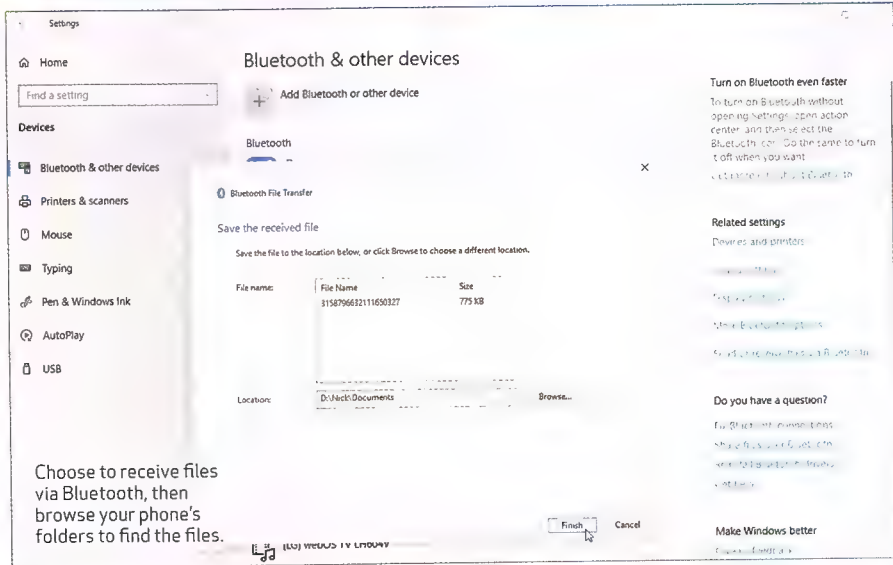
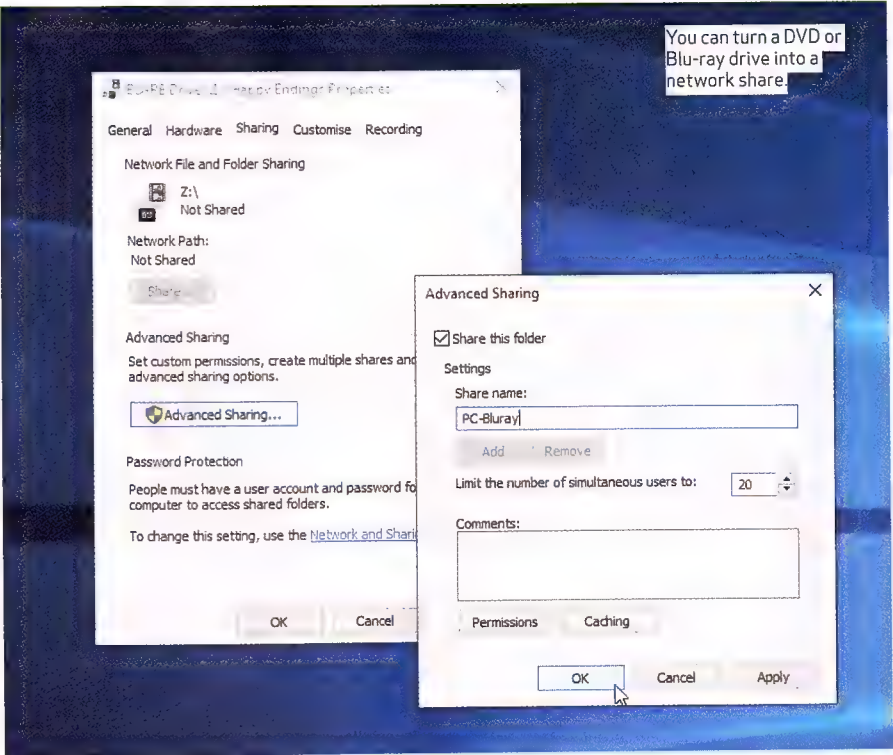
Carrie Marshall

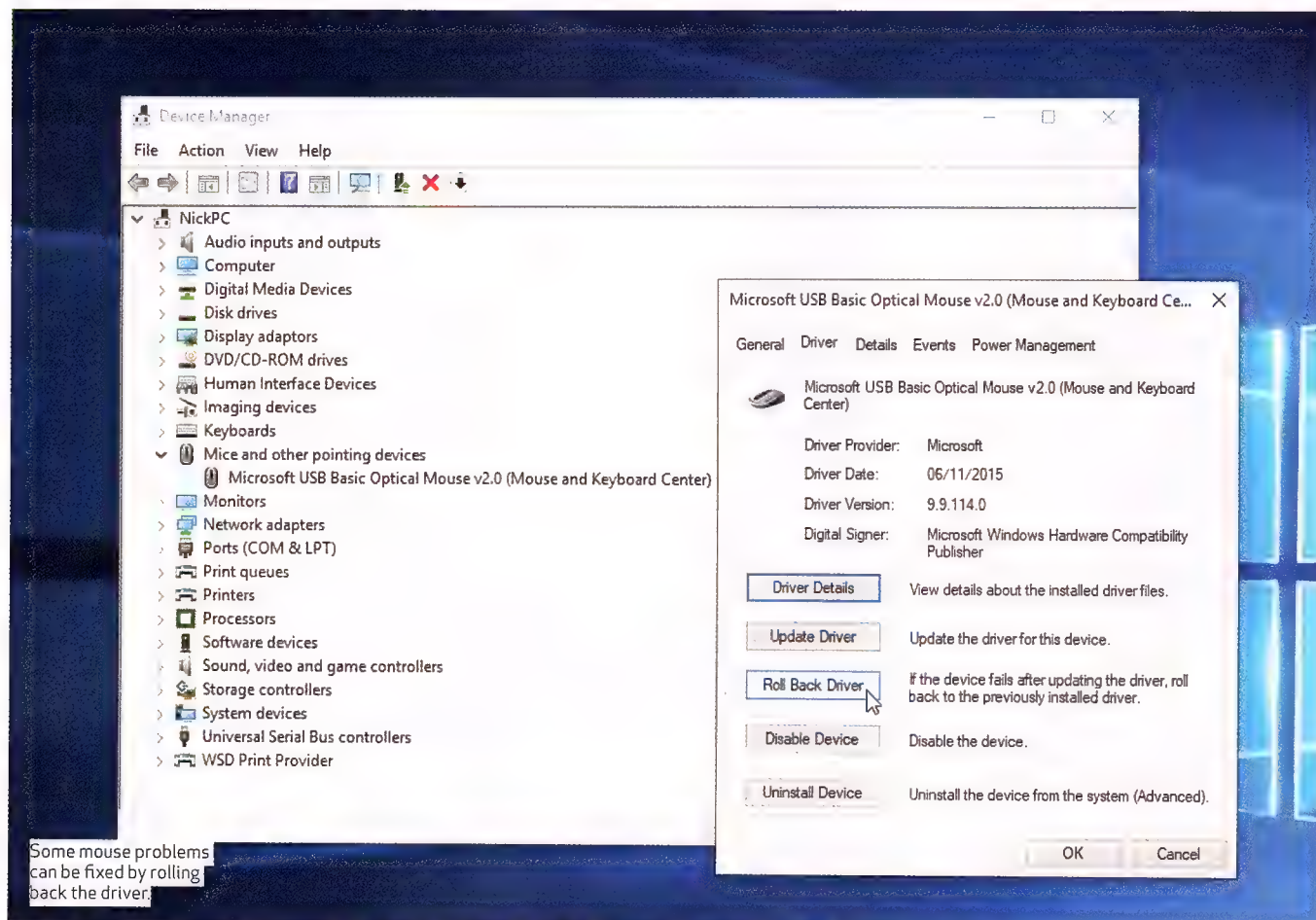
OFFICE

WORD CLOSE DELAY

Recently, I've noticed that Microsoft Word takes up to 30 seconds to close – I have several add-ins installed, could one of those be the culprit?

Karen Prentis





Some mouse problems can be fixed by rolling back the driver.

"Think about the possibility of wireless interference from another device using the 2.4GHz spectrum – unlikely, but if you recently bought wireless tech, try disabling that to see if the problem clears up."

This will almost certainly be linked to one of the add-ins you have installed. Karen had OfficeTab, Nitro Pro and Grammarly add-ins running, for example. To verify this, open Word while holding the Ctrl key and click 'Yes' to start in Safe mode when prompted. You should find it shuts down instantly. Next, go to File > Options > Add-ins. Click 'Go' next to 'Manage COM Add-ins' to see a full list. You can disable the lot, then – once you've verified one of them was causing your problems – re-enable them one at a time until the problem returns. Once identified, either remove the add-in or look online for a possible solution. Karen had most recently installed Grammarly, so started by disabling that. Word immediately shut down correctly – she then re-enabled it to discover the

problem had now magically vanished. However, after it came back a bit later she decided to remove the add-in and use the native Windows app instead. Carrie Marshall

HARDWARE MOUSE WHEEL JUMPS

I have a problem with a wireless mouse. When I use the wheel to scroll down the page, it tends to make the page go up as well as down rather erratically. I'm running the latest version of Windows 10 and don't have another PC to test the mouse on.
Ron Tropman

First, check for a possible driver update that might be the cause – go to Settings > Update & Security > 'View update history' to confirm there's no recent mouse driver update – roll it back if so in Device Manager. Next, try

Settings > Devices > Mouse to experiment with the scrolling settings. Obviously, Ron can't test the mouse on another computer to see if it's a hardware problem. Try changing the batteries in case they're running low. Next, check the scroll wheel for possible dirt or dust that can be cleaned out. Think about the possibility of wireless interference from another device using the 2.4GHz spectrum – unlikely, but if you recently bought wireless tech, try disabling that to see if the problem clears up.

Finally, consider the possibility that the mouse may be coming to the end of its life. If you have a wired mouse (or better still, another wireless mouse), try plugging that in; if the scrolling problem ceases, you'll have to replace the mouse.

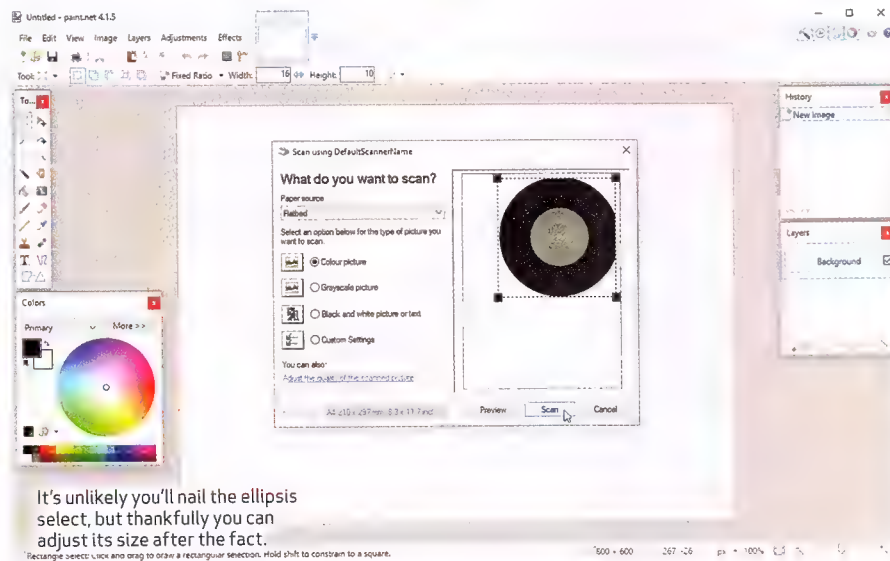
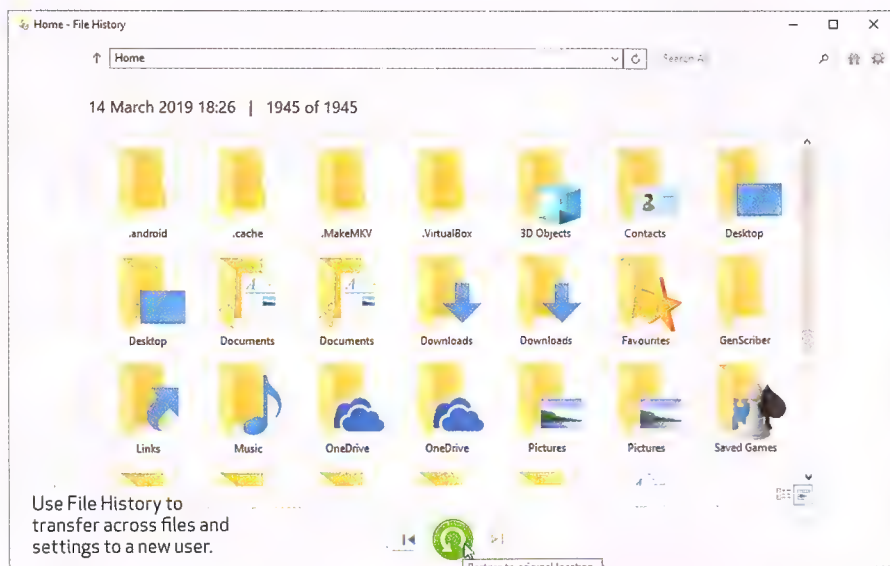
Rob Mead-Green

HARDWARE DRIVE FAILURE IMMINENT

Over the past few days I've been getting an alert: 'Windows detected a hard disk problem'. I've performed both a Windows 7 and Macrium backup and have recovery media for both. Can you advise me further?

Simon Jethwa

Sadly, this is a definite indication



the drive is failing. Simon confirmed this by interrogating the drive's SMART attributes with the help of Speccy (www.ccleaner.com/speccy). Despite the fact that individual attributes were listed as Good at the time, it was still marked with a warning, linked to the growing number of the 'Reallocated Sectors Count' figure. Within a few days – as we discussed possible drive-replacement options – the SMART attribute had switched to Bad, while Windows started hanging at shutdown. Thankfully, Simon has been diligent about taking backups, so he's well-covered. As he's planning to replace his 10-year-old PC next year, he's decided to avoid the extra cost of a SSD drive for now, instead choosing to replace the failing 500GB drive with a Western Digital Blue 1TB drive for under £60 online. Once it arrives, he can take one final drive image using Macrium Reflect Free (www.macrium.com/reflectfree.aspx), swap out the failing drive for the new

one, and then restore the image to the new drive using the Macrium rescue media.
Catherine Ellis

WINDOWS FAULTY START MENU

After updating to the latest version of Windows 10, I can no longer open the Start menu – clicking the button has no effect. How can I fix this?

This could be down to any number of things. Start by verifying that your system files haven't become corrupt somehow: right-click the Start button and choose 'Command Prompt (admin)' or 'PowerShell (admin)', then click Yes when prompted. When the command prompt window appears type `sfc /scannow` and press Enter on your PC keyboard to proceed. Wait for System File Checker to complete its scan. If it finds some corrupt files that it can't fix, type `DISM /Online /Cleanup-Image /RestoreHealth` and press [Enter] – wait again while replacement

files are downloaded to replace the corrupted ones. If this fails, consider biting the bullet and creating a new user account – if that fixes your Start menu problem, you will now need to migrate your files and settings from your old account to the new one using your current File History backup: go to Settings > Update & Security > Backup in your new user account profile, then select the drive containing your current backup.

Select 'More Options', then scroll down and choose 'Restore files from a current backup'. Verify that the backup is the latest one from your old profile, then simply click the Restore button to restore it to your new user profile. Once complete, verify everything is as it should be, then delete your old user profile (and files) via Settings > Accounts.

Mayank Sharma

MEDIA SCAN, CUT OUT AND ROTATE OLD VINYL LABELS

I used to use MGI PhotoSuite 4.0 on my old Windows XP PC to scan and cut out scanned labels of my record collection. Can you recommend something that works in Windows 10?
Gilles Valiquette

Most free image editors have the tools you need, including Paint.NET (www.getpaint.net). Open the file or scan it into the program via File > Acquire, then follow this guide.

Choose the ellipsis selection tool from the Tools dialog box. Position the cursor to the top left of the area that you wish to keep, then press and hold Shift as you click and drag to create and move the circle into position.

You're unlikely to get it perfectly into position. Switch to the Move selection tool (the white arrow) and use the drag handles – keeping Shift held down – to adjust the size. You can also click and drag the selection until it's perfectly in place.

Choose 'Edit' > Invert Selection to select everything outside the section you wish to keep, then press Delete to remove it. If your selection isn't pixel-perfect, press Ctrl-z twice, refine your selection further and then try again.

If the label isn't aligned correctly, select Layers > Rotate / Zoom. Click and drag on the Roll / Rotate circle to manually rotate the label or use the top slider to enter a figure between -180 (anti-clockwise) or +180 (clockwise).

Rob Mead-Green ■

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Surf more safely

Ian Evenden says the internet can seem like a scary place, but with the right combination of settings and apps, you can cut right through the online mire.

To believe some sections of the press today, it's impossible to go on the internet without having your computer taken over by hackers, who will use it to mine pornography using something called a "blockchain", stealing your credit card details, and those of your

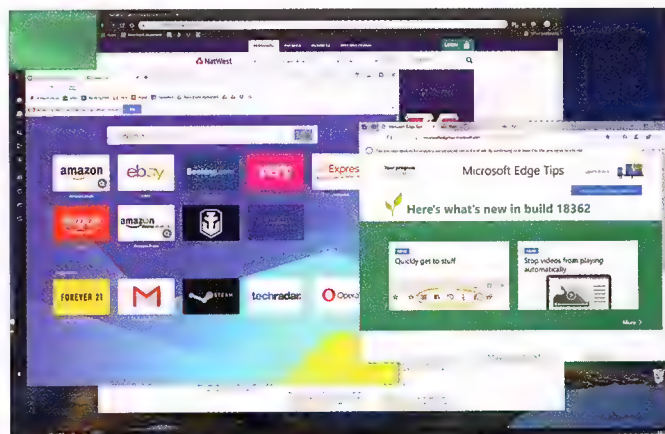
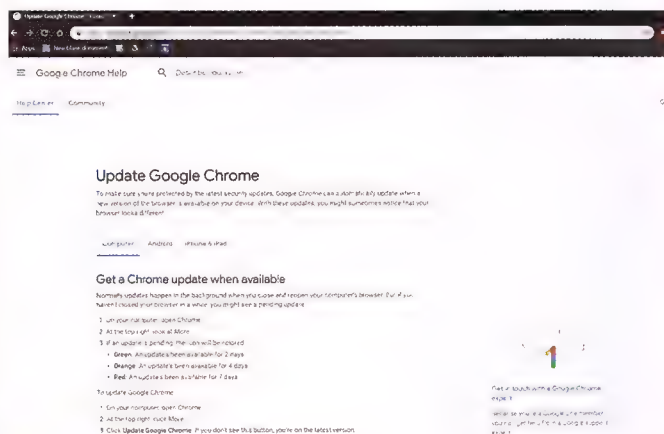
94-year-old grandmother who's never been online, in the process.

Things might not be that bad, but the threat of malware, unwanted apps that can hijack your PC or hold it to ransom, is real.

There's plenty you can do to protect yourself, and your grandmother,

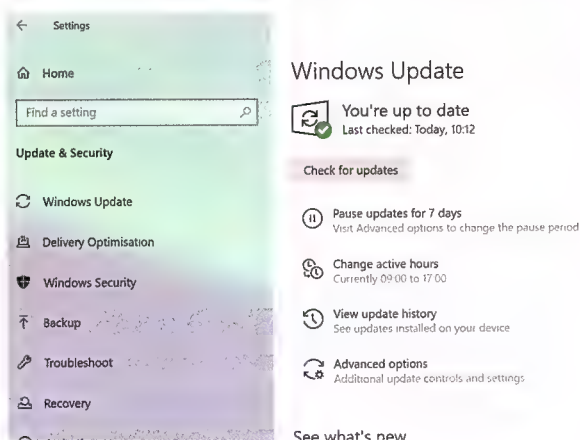
however. Some of it involves adding additional programs to your PC, but there are steps you can take that need nothing more than a web browser and your operating system.

We'll also touch on both ad and cookie blocking, and on making surfing the web a nicer experience.



1 KEEP YOUR BROWSER UP TO DATE

Whichever browser you use, make sure you have the latest version, as they're constantly being patched. Edge receives its updates via Windows Update. Chrome gets them automatically – click the ellipsis (...) to see if there's one available, otherwise it will be installed next time you restart the app. Firefox does this too – go to Help > About Firefox to see if there's one pending.



3 KEEP WINDOWS UP TO DATE

Here's something else that should happen automatically, but which is worth checking up on every now and then. Opening Settings > Update & Security will tell you if you're up to date, but click the 'Check for updates' button to see if there's something ready to download. Windows is much better about restarts, too, enabling you to defer them until you're ready.

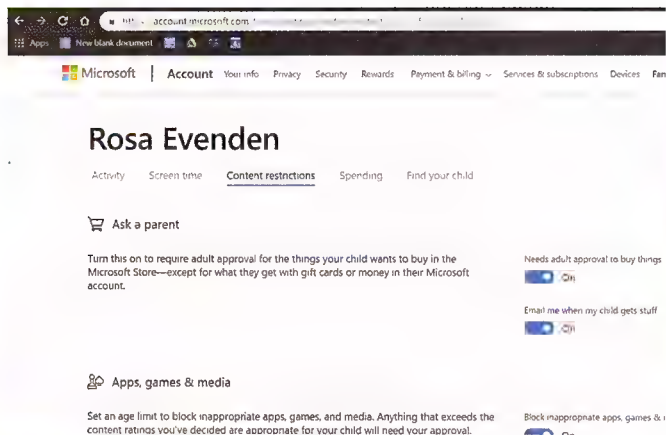
2 USE MULTIPLE BROWSERS

The theory here is that, if one browser knows your Facebook account, another your bank account, and another your Amazon account, anything nasty that comes your way via Facebook won't be able to hop to Amazon. It's an old-fashioned idea, and relies on you remembering which browser does what, but it's effective especially if you poke about in unsavoury corners of the web.



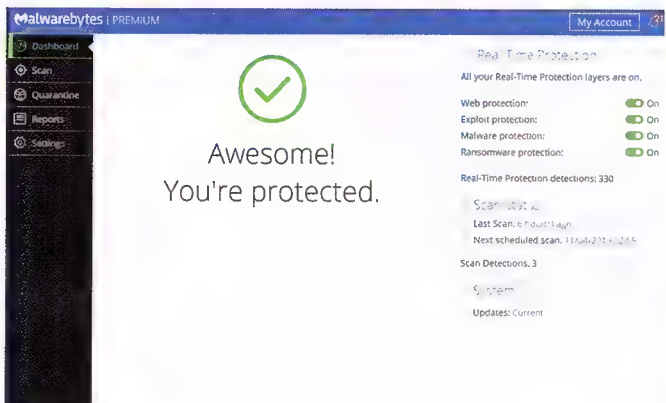
4 MASTER WINDOWS SECURITY

Windows 10's security centre has a lot of options. If you're not using a separate anti-virus app, keep Real Time Protection turned on in 'Virus & threat protection'. And even if you are using another provider, use Windows' built-in tools for a quick scan. Under 'App & browser control', turn SmartScreen on to prevent, or at least warn about, unwanted files from executing programs.



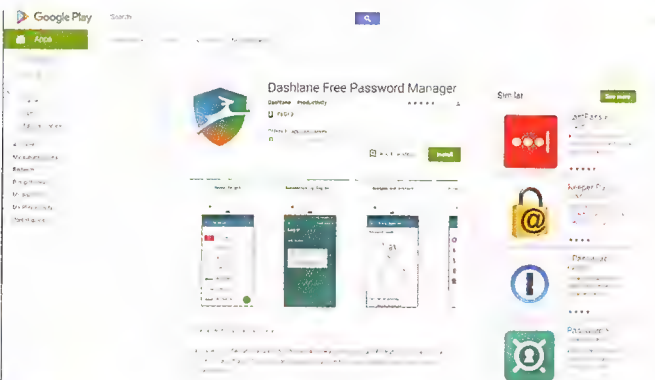
5 FAMILY SETTINGS

Under Security > 'Family options' you'll find settings to limit the sites your kids can access with Edge. Family members need their own Microsoft accounts, which adults can administer for them. When you do this, you can control whether they can sign into third-party apps or are locked to Microsoft's own. You can also set content restrictions, screen time limits, and much more.



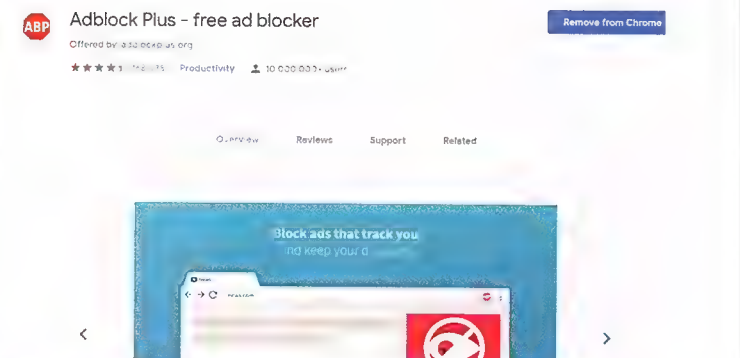
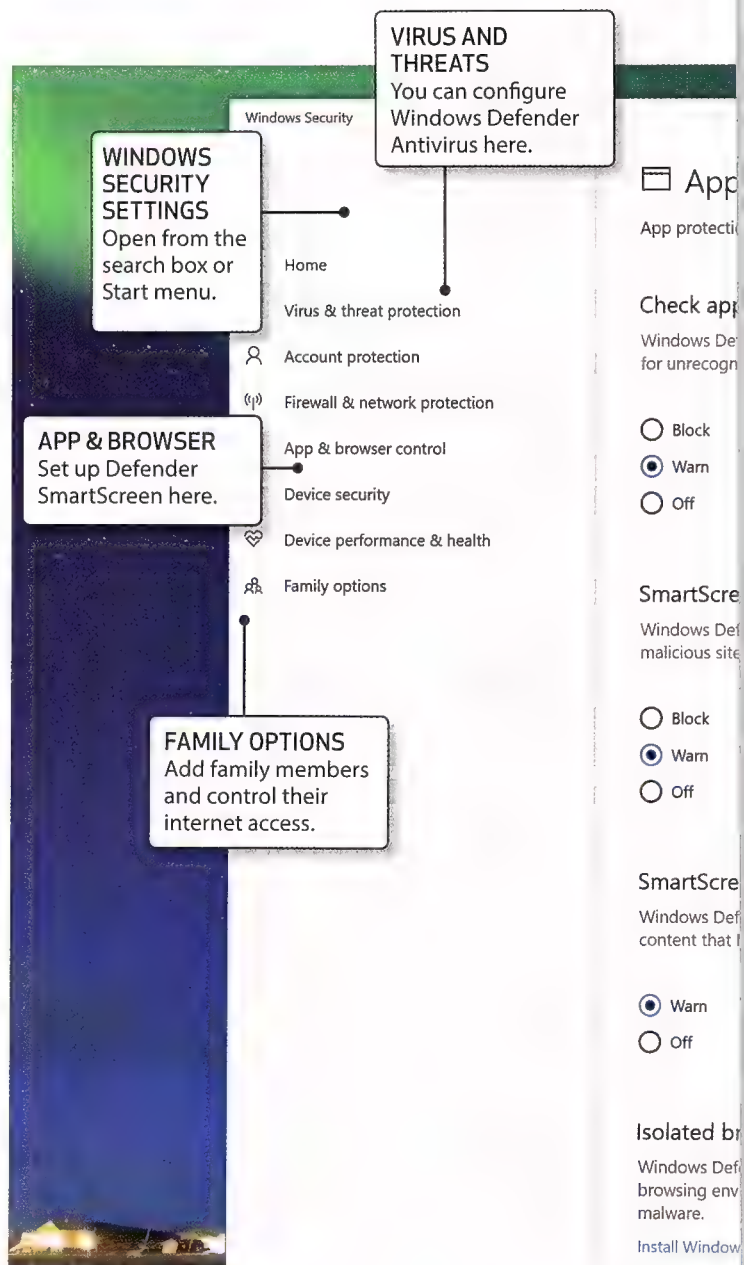
6 CHECK FOR MALWARE

There are several anti-malware packages available that complement or replace Microsoft's own, but one of our favourites is Malwarebytes. It offers real-time protection against online exploits, malware and ransomware, regularly scans your system for threats, and produces reports to tell you what it's done. This comes at a cost, however, with an annual subscription available.



7 USE A PASSWORD MANAGER

Password managers remember your passwords for you and lock them behind a single master password. This enables you to use strong, randomly generated passwords, that are hard to guess, but impossible to remember. Web browsers will also offer to remember passwords for you, and you can use a site like <https://passwordsgenerator.net> to create them, too.



8 BLOCK ADS AND COOKIES

Still controversial 13 years after its release, Adblock Plus is a browser plug-in that blocks adverts on websites. Partly this is to do with aesthetics, but also security. It will also block cookies from being stored on your PC and the tracking pixels ad networks use to deliver the same ads to you whichever site you're on. Available for Firefox, Chrome, and as a beta for Edge.

er control

urity.

en helps to protect your device by checking
es from the web.

soft Edge

en Filter helps to protect your device from
s.

soft Store apps

en protects your device by checking web
apps use.

on Guard opens Microsoft Edge in an isolated
ter protect your device and data from

ication Guard

SMARTSCREEN

Works across apps,
Microsoft Edge and
downloaded files.

PRIVACY SETTINGS

Control tailored
adverts, let Windows
track app launches,
and more.

Windows Community videos

Learn more about App & browser
control

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Get help

Who's protecting me?

Manage providers

Help improve Windows Security

Give us feedback

Change your privacy settings

View and change privacy settings
for your Windows 10 device.

Privacy settings

Privacy dashboard

Privacy Statement

Jargon buster

TRACKING

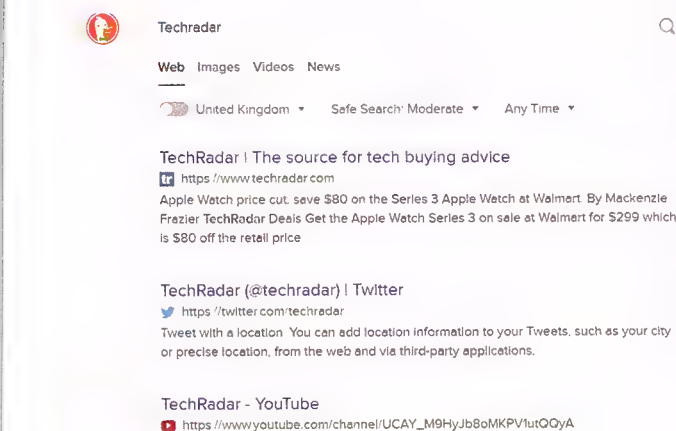
Advertisers acquire
data for marketing
by analysing your
online activity.

ADS

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images to flashing text
or autoplaying videos.

UPDATES

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or for Windows, having
automatic updates
switched on will
protect you online.



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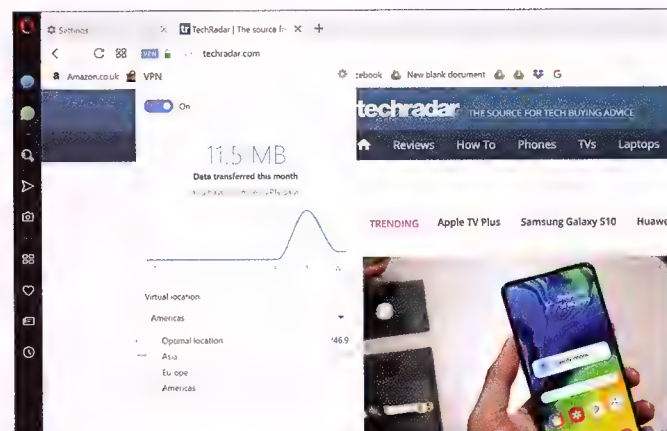
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Optimal location: Asia

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9 SEARCH MORE PRIVATELY

Although it is famous for its search engine, Google is mainly an advertising company, and the personal details of its customers are useful to it. DuckDuckGo is a search engine that doesn't track you and doesn't store any of your personal details or search history. It makes money through affiliate marketing, whereby small ads are attached to your searches.

10 USE A VPN

A Virtual Private Network (VPN) masks your location from the sites you visit by making it appear you're browsing from elsewhere. This means you can access sites that are blocked in your locality, and browse any site anonymously. There are paid-for VPNs out there, but the Opera browser (www.opera.com/) comes with a free, unlimited VPN facility and a built-in adblocker, too.



Tame Siri and Search

Alan Stonebridge shows you how to personalise your device's helpful nature.

With the introduction of iOS 12 came a bunch of improvements and customisations for Siri & Search that improve your iPhone and iPad's helpfulness.

After using iOS 12 for a while, it'll suggest actions on the Lock screen when you wake your device. Those are the result of on-device intelligence that learns about your usage – not just of Apple's own software, but third-party apps too. If an app has been updated to work with this, suggestions may be very specific, such as 'Show my recent contacts' in Cardhop or 'Schedule for today' in Fantastical.

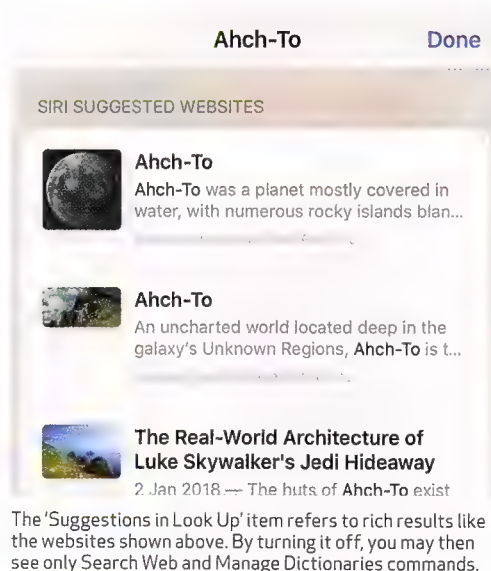
Siri takes repetition, the time of day and your location into account for its suggestions. As well as the Lock screen, suggestions can appear in iOS's search results and in iOS's Look Up feature.

You may want to stop info from some apps leaking out onto the Lock screen in particular, so we'll show you how.

MAKE IT MORE PERSONAL

It's possible to assign personalised voice commands to suggestions. If you've turned on Type to Siri (see step 7) to avoid speaking to your phone in public, typing those phrases may seem like a lot of work. So, add iOS's Text Replacement feature into the mix.

By doing that, rather than type even short commands like 'Text the boss', you can have iOS replace stuff like '#txboss' with 'Text <your boss's full name>'. Boom! This requires some extra thought to prepare, but it means you can still perform complex actions with a few key taps instead of jumping to and around another app manually.



"Siri takes repetition, the time of day and your location into account for its suggestions."

How to tailor Siri and Search to you



1 SIRI IS CLEVER!

Siri's on-device intelligence learns from what you do with the apps on your iOS device. It uses that info to suggest things you might want to do based on observations of past regular behaviours, such as at a particular location or time.

< Siri & Search Messages

Siri & Suggestions

Allow on Lock Screen

Allow information from "Messages" to appear in Search, Look Up, Keyboard and Lock Screen. Siri may learn from and make suggestions based on how you use the app.

4 CONSIDER YOUR PRIVACY

You might keep it turned on to benefit from Siri's suggestions, but turn off the second (Allow on Lock Screen) for privacy. That will prevent hints that you use the app – and actions you take in it – being seen by onlookers.



Add to Siri

Record a new voice memo
Voice Memos

7 EXPLORE COMMANDS

Tap one there, or tap All Shortcuts to browse/search a longer list of actions and tap one of those. On the next page, tap the red record button – or tap Type Phrase, if Type to Siri is turned on in Settings > General > Accessibility > Siri.

SIRI SUGGESTIONS

Suggestions in Search

Suggestions in Look Up

Suggestions on Lock Screen

Siri can make suggestions in apps or when you use Search, Look Up and Keyboard. About Siri Suggestions & Privacy...

2 REIN THINGS IN

In Settings > Siri & Search, under Siri Suggestions are three switches you can turn off to prevent suggestions appearing on: the Lock screen; in search results (at the Home screen or Today view); and when you select text and tap Look Up.

< Siri & Search Messages

Siri & Suggestions

Allow information from "Messages" to appear in Search, Look Up, Keyboard and Lock Screen. Siri may learn from and make suggestions based on how you use the app.

Show App

5 INCLUDE AN APP AT ALL?

If you do turn off the first switch, the second becomes irrelevant anyway and is replaced by Show App. Turn that off if you want the app never to appear in Search/Today view's suggestions widget and among search results when you type.



8 SAY YOUR PHRASE

Say the phrase you want to trigger your action, then tap the red stop button. Tap Done if Siri heard correctly, else try again. You'll be taken to Settings > Siri & Search > My Shortcuts. Use this list to review/remove custom voice commands.

Maps

Siri & Suggestions, Find in Apps

MARIO RUN

Siri & Suggestions

Measure

Siri & Suggestions

Messages

Siri & Suggestions

3 APP-SPECIFIC CHOICES

Lower down, tap an app to refine its Siri integration. The first item enables info from the app to appear in Search's results, Look Up, on the Lock screen, and in keyboard's suggestions. Turn it off if you never want suggestions for this app.

SUGGESTED SHORTCUTS

Compose Email

+

Send a message to Darryl

+

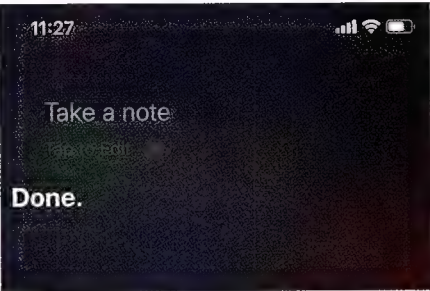
Play What's Going On [Deluxe Editi...]

+

Mercy Mercy Me (The Ecology)

6 PRE-EMPT SIRI

You can set a Siri voice command to carry out an action you perform often, using a phrase of your choice. At the top of Siri's settings page, under Suggested Shortcuts, are three actions Siri thinks you might want to do this for.



9 TRY IT OUT

Call for Siri's help however you prefer – holding the side/Home button or perhaps by saying "Hey Siri", then say the phrase you just assigned. Siri will then coordinate with the relevant app and get it to do what you asked.



Clean your Mac to sell it

Deauthorise, sanitise and initialise your Mac ready for its new owner. Howard Oakley shows you how.

When you sell your Mac, it's wise to back up everything from it so that you don't lose important documents or apps. You should also clean it to ensure its new owner doesn't get handed any sensitive information, such as your passwords and data.

Before following these steps, remove any firmware password you may have

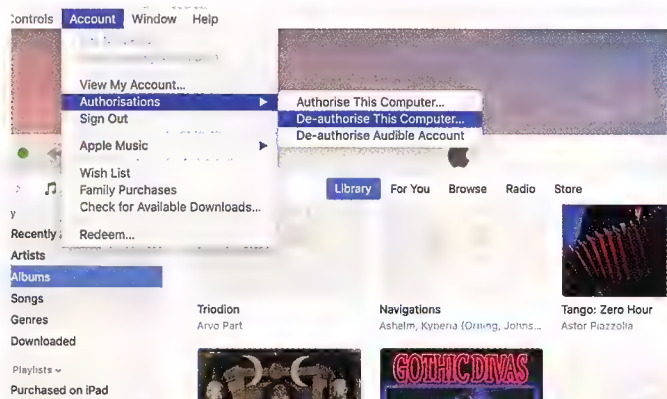
set (see bit.ly/mffwpwd), re-enable System Integrity Protection if you turned it off (bit.ly/mfsipen), and remember to make that backup!

Then check through any apps which are licensed by serial numbers or authorisation schemes, and deauthorise the copy on that Mac. You may need to consult the vendor's support site for info. This is now simpler with products from Adobe and

Microsoft, which normally only require you to log out of your online account. Apps from the Mac App Store are covered by the process below.

Ideally, have a fast internet connection available, as your Mac will download a full macOS installer at the end of it all.

How to reset your Mac before selling it



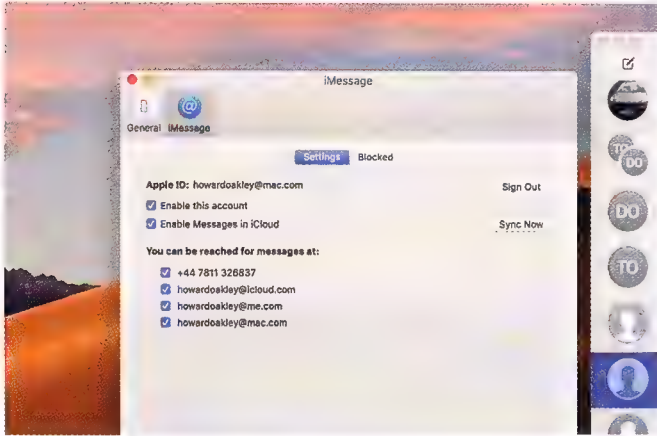
1 DEAUTHORISE ITUNES

In iTunes, go to Account > Authorisations > Deauthorise This Computer. Enter your Apple ID's password and allow the process to complete. If you forget to do this, you can only deauthorise all computers later (bit.ly/deauitu).



2 SIGN OUT OF ICLOUD

Open System Preferences' iCloud pane and click the Sign Out button. Although this isn't essential, it makes it harder for anyone to try to access your account once your Mac is no longer in your possession.



3 SIGN OUT OF MESSAGES

In this app, go to Messages > Preferences. Click the iMessage tab in the new window, then click the Sign Out button to ensure this Mac stops getting messages that are pushed by Apple's server to your Apple ID.



4 UNPAIR BLUETOOTH DEVICES

If you're passing on the keyboard and mouse/trackpad, leave those paired for the next owner. In Bluetooth prefs, select other devices you want to unpair in turn, clicking on each one's X so the Mac forgets them.



5 ERASE INTERNAL STORAGE

In Recovery (bit.ly/mfrvcvry), open Disk Utility and choose View > Show All Devices. Select the internal drive and click Erase. If it's a hard disk or Fusion Drive, click Security Options and select a suitable erasure level.



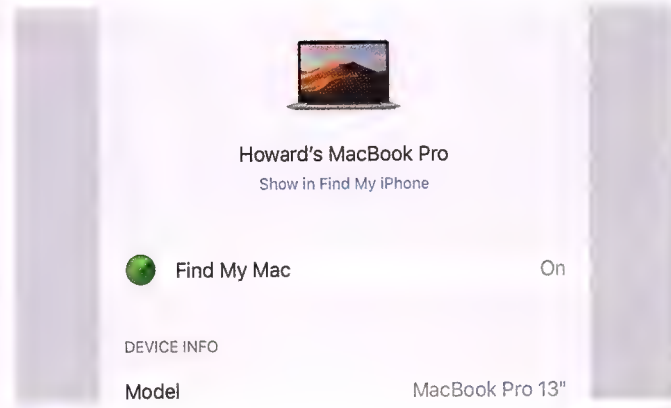
6 INSTALL MACOS

Still in Recovery, you should now install macOS onto the erased internal storage. By entering Recovery using command-R, the option to install macOS should give you the same version you've just been running.



7 QUIT THE SETUP ASSISTANT

Wait for the macOS installer to finish up. When it reaches the Welcome screen, press command-Q and click Shut Down. When the Mac's new owner starts it up, they'll get to set it up as if it were fresh from the factory.



8 REMOVE FROM YOUR ACCOUNT

Keep a note of the Mac's serial number. Once your Mac has gone, if you have an iOS device, open Settings > [your name] and locate that Mac in the list of products. Check it's the right one, then tap 'Remove from Account'.

Manage your Linux game collection with Lutris

John Knight stress-tests Lutris and finds some gaming heaven and hell – though hopefully, it's more of the former.

Rather than being some sort of a skin cream, Lutris (<https://lutris.net>) is a gaming client for Linux, with a focus on gaming preservation and centralisation. From a single interface you can run anything from old Sega games to modern AAA games using Wine or Proton. According to its website, "integration with stores like GOG and Steam allow you to import your existing game library, and community maintained install scripts give you a completely automated setup". The Lutris downloads page has instructions for installing on a wide variety of distributions, as well as links and recommendations for playing most Windows games through Wine.

BLANK SLATE

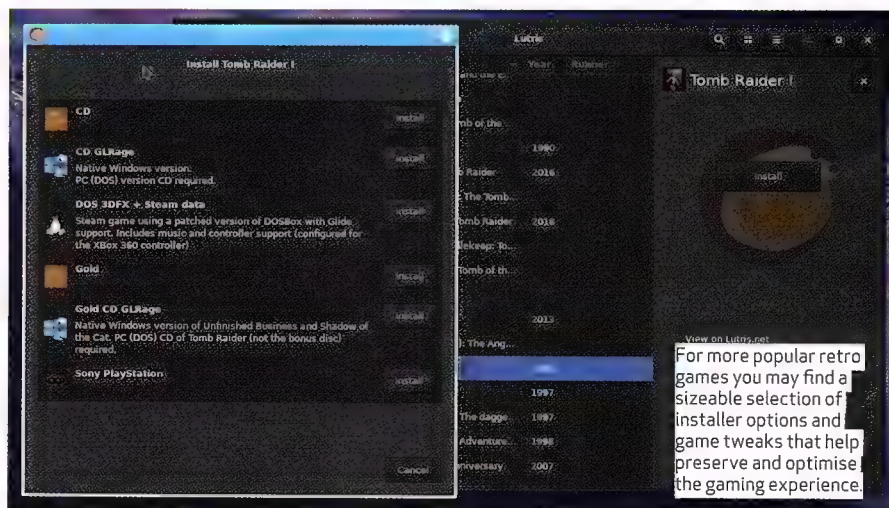
Open Lutris and you'll be presented with a lot of blank white space – so other than changing the colour scheme to black, you'll want to add some games! Lutris has an extensive gaming database on its website, which you can browse using the search bar on the right. Enter a search term and a list of games appear in the main field. Don't get your hopes up: they're not all free, and for most you'll either have to buy something or download some kind of ROM to get it working.

Select a game and you're given the option to install it or view it on **lutris.net**, with info on how well it will run and any issues you may encounter. The Lutris database can be browsed either through the app or in your web browser, with each category based on 'runners'. Click Install and you're taken through a series of GUI prompts, ideally with all optimisations pre-prepared.

If you don't own any games, Lutris has a collection of free and open source games you can play, with dedicated buttons for this at the right of the window.

THE RUNNING MAN

Runners are really what power Lutris. Runners are programs managed by Lutris that can run games, whether it be Linux itself, Wine, DOSBox, MAME, gzdoom and so on. Each installer script is assigned a runner, and programs



"If you don't own any games, Lutris has a collection of free and open source games you can play."

usually become runners if they can run a variety of games, not just one or two.

To see what's on offer, there's a button to 'Manage Runners' near the top-left of the window. Although there are services such as Steam and browser links, most of these runners are emulators. Any runners that are not installed will be greyed out, and if you look around the window there will be two buttons: one to install a runner and one to configure it.

Rather brilliantly, instead of you having to find binaries for your system or compiling something, Lutris has pre-made packages and will download and install them. To add a game manually, click the + sign at the top of the window and click 'Add Game'. The 'Add a new game' window opens in the Game info tab. Here you enter the name of your game and select its runner; you can also enter the year it was released. If the runner you need isn't in the drop-down list, the 'Install runners' button opens the Manage Runners window, where you can get more.

The next tab is 'Game options', which changes depending on the runner being used. For instance, with PSP games you

choose an ISO file, and with Steam games you enter the application ID, with an extra box for any launch arguments. Moving along, the 'Runner options' tab has switches to override the default configuration, such as whether to run in fullscreen or to start Steam in Big Picture mode.

Lastly is the 'System options' tab, where the real tweaking lies. The 'Default installation folder' is worth defining, but we particularly like the option to switch resolutions, as well as the switch to restore your resolution on game exit. It's well worth clicking the 'Show advanced options' button, because there are excellent features available, such as restricting the game to a single CPU core, or switching to a US keyboard layout. When you've finished, click the Save button, and your game should appear in the main list. Select your game and click the Play button on the right – all going well, it should launch. If not, you'll need to go back and tweak some of those options (right-click on the game and choose Configure).

SOMUCHWINING

Lutris enables you to import existing games, adding them to your menu in big batches. These include games from Linux itself, GOG, Linux Steam, and the Windows Steam client using a Wine runner. Note that you can only import Steam games that are already installed locally.

To import games, click the + sign in the top-left corner and choose 'Import Games'. The window is split into tabs based on the runner used. Each tab has a list of games to select – just click 'Import games' when you're done. The games you've imported should be in your menu; click All from the Runners menu if you can't find them.

In our experiments with GOG we found some games just wouldn't import, such as *Tomb Raider 2* or the original *Mortal Kombat* DOS games, yet *Tyrian 2000* had an automated installer script. It failed, admittedly, but at least it had one. Whether a game has an installer or not is hit and miss: some do, some don't, and anything missing an installer has the option to write one yourself.

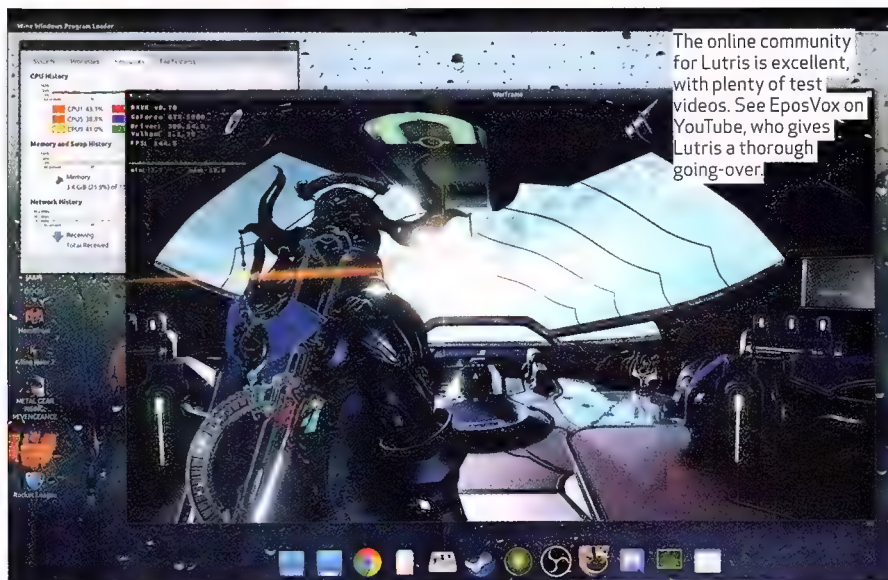
Annoyingly, *Blakestone* had fullscreen issues, running in a tiny window surrounded by black. Using GOG's manual Linux installer, it ran perfectly in fullscreen and made a menu entry in KDE, which Lutris didn't manage. The same thing happened with *Cyberia*. On the bright side, PSP ROMs worked perfectly.

Windows gaming is where Lutris really shines. It's fine having Steam and Proton, but not everything is available as a Steam app. *Overwatch* is a prime example – some people are using Lutris just to play that! Whereas Valve's Proton takes a one-size-fits-all approach, Lutris uses individual scripts that optimise settings for each game, such as specifying which version of Windows to simulate, which version of Wine to use, and so on. For some Steam games Lutris will run Windows Steam through Wine, instead of Linux Steam with Proton – though you will usually be given a choice between the two.

We used *Warframe* as a test, which is free to play with only a Silver rating on Proton (meaning compatibility is hit-and-miss), but has a Gold rating on Lutris. *Warframe* came with the Windows client as the only option, but heavily optimised, with Esync and DXVK enabled. It downloaded a specific version of Wine, and chose Windows 7 as its environment. That was encouraging, and results online have generally been pretty impressive.

PRIME TIME

Lutris is certainly ambitious, but do you need it in your life? Well it's not without problems. Firstly, it's still buggy and for most games the one-click experience we'd hoped for simply wasn't there



"Windows gaming is where Lutris really shines. It's fine having Steam and Proton, but not everything is available as a Steam app."

– especially with old emulated titles, which require you download a disk image and then point the installer at it. The fullscreen issues with Linux GOG games actually made things more inconvenient, and a server error with **gog.com** temporarily broke any import functionality.

A central place for all your games is a nice thought, but convenient installers require scripts be written for each game, which is simply impossible for the entire history of gaming. Adding ROMs manually will just be a pain. So if you're a retro gamer, no, it's probably not what you're looking for – but for

modern gaming it's a different story.

Whether you want to centralise your games or not, if you're serious about modern PC games on Linux you need Lutris. Even putting non-Steam games aside, there are plenty of games that don't work under Proton but do work under Lutris, so by combining the two your gaming library can be potentially massive.

Even though it will take time for Lutris to mature, it already has a large fanbase. As Linux gathers momentum as a viable gaming platform, Lutris is sure to be at the heart of gaming-focused distributions. ■

Wine: Managing a vast cellar

If neither regular Wine nor Proton will suffice, Lutris has an entire management system for picking the best version of Wine – there are even versions optimised for specific games. Of chief interest are the tkg builds of Wine.

Put together by Tk-Glitch, wine-tkg aims to be "the Wine to rule them all", by combining Esync and DXVK with regular Wine, along with D9VK and VKD3D for Direct3D 12 support. DXVK is the compatibility layer upon which Valve's Proton is famously based, and translates between Direct3D 11 and Vulkan – the much faster replacement API for OpenGL.

We could barely understand a word of Esync's documentation, but there are some deeply impressive optimisations based around executing operations in user-space. Combine Esync with DXVK and you have a potential gaming powerhouse.

Before you try anything outlandish, install the Wine Steam runners first or you'll just get 'file not found' errors. We were hoping these would be installed automatically when installing a Windows Steam game, but never mind. If you're manually selecting which version of Wine you want as a runner and you want to use wine-tkg, you need to download one of the versions available in the Wine version manager.

Faster charging – without the tricks

You don't always need the latest technological tricks to get faster charging. Sometimes, some basic electronics knowledge can go a long way. Darren Yates explains.

Charging your phone each night for the day ahead has long been part of the daily grind. There's no doubt phones are improving their energy efficiency, but no matter how well you plan, there'll always come a time when you're caught short and your phone is out of charge, you've lost the USB cable or even the USB adapter itself. No worries – any USB port in a storm, you say. Not if you want to maximise your phone's charge speed, you don't. There are plenty of fast-charging tricks available these days, but here's the thing – every phone might be different, but no matter the brand, they're all bound by the basic laws of electronics and if you understand the basics, you can put them to work for you. This month, we explain how USB charging works, we look at adapters and cables, what the hieroglyphics on your USB adapter mean – and how to maximise charge speed.

ALL ADAPTERS ARE THE SAME, RIGHT?

If you're anything like me, you'll have gathered quite a collection of USB adapters over the last decade. They come in a range of shapes, but all with the same goal – to turn Australia's nominal 230-volts AC mains power into a device-happy 5-volts DC voltage.

Except, that isn't quite true – not when you add in the higher-voltage higher-speed charging tech offered by the likes of Qualcomm, Samsung and others. Fast-charging technologies such as Samsung's Adaptive Fast Charging or Qualcomm's QuickCharge deliver not only the USB-standard 5VDC output to your device, but they can also produce a higher-voltage output of 9VDC, for example, to supported devices.

VOLTAGE X CURRENT = POWER!

The official mains voltage at your wall outlet is 230VAC, but if the electricity to feed every home in Australia came down those big transmission lines at 230VAC, the cables would have to be as thick as 100-year old eucalypt trees to cope with the required flow of electrons or 'current'. So instead, the power

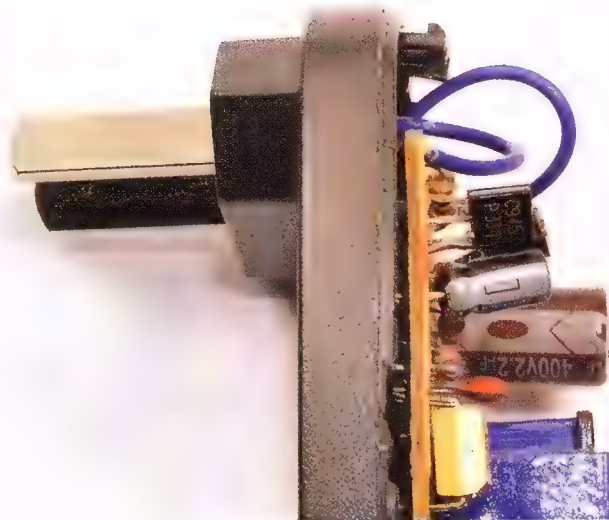
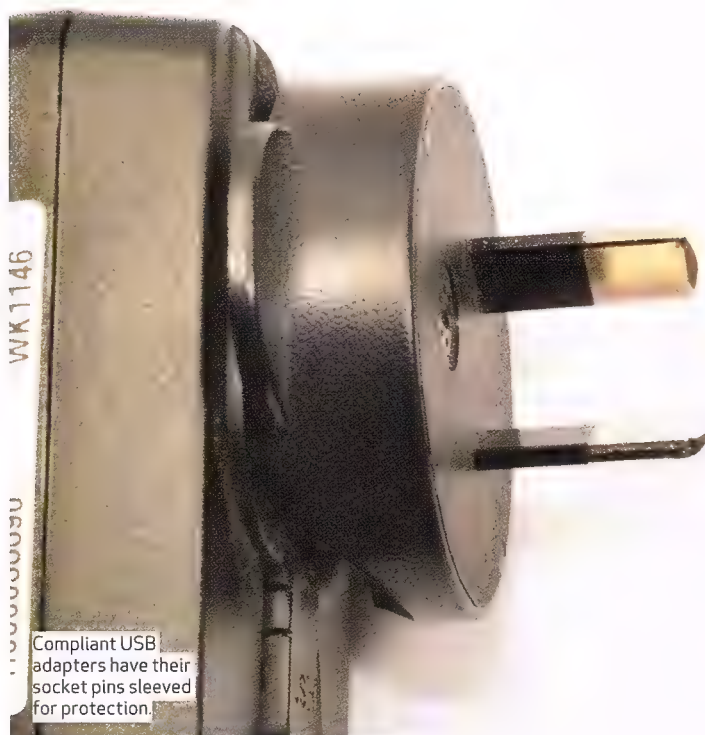
Samsung's Adaptive Fast Charger has two output device-chosen settings.

SAMSUNG TRAVEL ADAPTER
MODEL: EP-TA20HWF
INPUT: 100-240V ~
50-60Hz 0.57A
OUTPUT: 9.0V = 1.67A in
5.0V = 2.0A
S/N: R37KBQX1ME4SE3
Adaptive
Fast
Charging
MADE IN VIETNAM

"While a phone will have a maximum charge current it can accept, USB adapters also have a maximum current they can deliver."

Learn to understand the voltage label, particularly the 'output' section.

AC ADAPTER
MODEL: C-P48 SPN5953A
INPUT: 100-240V ~ 50/60Hz 0.3A
OUTPUT: 5.2V = 2.0A
MADE IN CHINA AcBel
713-1292
SAA-160836-EA



generators jack up the voltage to typically 132,000-volts on the long-run transmission lines, drop it down to 11,000-volts on the power lines in your street and finally the 230-volts that comes into your home.

High-voltage USB charging sort-of works along the same lines. For example, the Samsung Galaxy Tab A 10.5 tablet comes with an Adaptive Fast Charger, offering 5VDC at 2.0-amps of current or 9.0VDC at 1.67-amps. Electrical power, measured in watts, is equal to voltage times current, so at the 5VDC rating, we get $5.0 \times 2.0 = 10.0$ -watts, but at the 9VDC rating, we get $9.0 \times 1.67 = 15$ -watts. So, the Adaptive Fast Charging system can pump in 50% more power into the tablet, which it uses to charge the battery faster.

SHAKING HANDS

Another way of looking at this is that your device battery is a store of electrons and the charge current is the rate of electrons flowing into the battery, so the higher the charge

current, the sooner your battery will reach its fill of electrons.

But as always, it's never quite that simple. The process of charging your phone's battery via USB is actually an electronic negotiation between two components – your phone's circuitry and the USB adapter. There's a good reason for that, too. If you charge a Lithium-ion/polymer battery too fast, you risk all sorts of pyrotechnics. So, manufacturers keep a lid on the charge rate to ensure you stay safe by using the USB-PD (Power Delivery) standard. This requires the two devices communicate or 'handshake' to set the ideal charge current.

While a phone will have a maximum charge current it can accept, USB adapters also have a maximum current they can deliver. The handshake negotiations allow the two devices to compare maximums and set the charge rate to the smaller of the two. For example, say you plug your 2017 Motorola Moto G5 phone, which has a 2.0-amp max charge current rating, into

a USB adapter with a 1.0-amp maximum output. The two devices greet, compare notes and decide that since the USB adapter has the lower rating, that's what they'll set the charge rate to. The downside is the charge rate is now only half the 2.0-amps the phone supports and it'll now take twice as long to charge.

USB ADAPTER LABELS

This is why it's vital you can read and understand the power label stamped on the back of a USB adapter. While no two labels will be the same, you should be able to pick out the key details, which should be broken down into two sections – 'input' and 'output'.

The 'input' will refer to the AC mains voltage the USB adapter gets from the wall socket. Any USB adapter worth its components will be a 'universal' type that handles mains voltages from 100 to 240VAC at either 50 or 60Hz frequency. These adapters can be used virtually anywhere in the world with the right travel adapter, which is what makes

Belkin is one of the safe third-party USB peripheral brands.

Your older USB adapter should work, but likely deliver less charge current.

Name-brand USB adapters are the safest bet, but not the only option.



Use a USB voltmeter to measure charge voltage and current into your phone.



"You can buy all sorts of electronics components online from overseas. However, there's one category I won't buy – and that's USB adapters."

them 'universal'. To operate in Australia, an adapter needs to accept 230/240VAC.

The 'output' section notes the maximum power it can deliver to your device. Here, the key specs are in two parts – first, it should output a minimum of 5-volts or 5.2-volts DC. Instead of the letters 'DC', you'll likely see a symbol featuring a solid line over three shorter lines – this is an international symbol for 'direct-current'. After that symbol, you should also see the current output rating in 'amps' or 'A' for short. This is the key spec to recognise – cheaper or older USB

adapters may output only 0.5A or 500mA (500-milliamps), others 1.0-amp (1A), more recent adapters '2A', while USB-C adapters can in theory go up to '5A'. While a 1A-or-lower rate all but guarantees your phone will take longer to charge, connecting a 5A adapter to your phone won't guarantee you'll get the 5A charge rate – again, it depends on whether the device (and battery) support it or not.

But within reason, the higher a USB adapter's output current rate, the better.

BE CAREFUL WHAT YOU BUY

You can buy all sorts of electronics components online from overseas. However, there's one category I won't buy – and that's USB adapters. There's certainly no shortage of them available – you can find USB adapters with Australian-style angled-pin plugs selling for as little as \$4 including shipping. Why is this a problem? Because you can't be sure how safe they are.

All major trading countries have national safety boards that set standards for devices like USB adapters. In Australia, the 'C-Tick' mark, regulated by the Australian government under the Radiocommunications Act 1992, has often been seen as the local electrical safety mark. The problem is, it's actually not – C-Tick indicates a device has been tested and passes EMC or 'electromagnetic compatibility' tests, not electrical safety tests. Over the last few years, though, a new RCM or Regulatory Compliance Mark has been introduced to indicate both EMC and electrical safety approval test compliance. You'll see it on the details panel on the back of newer USB adapters.

Unfortunately, however, it's easy enough for a dodgy manufacturer to slap an RCM or C-Tick on a USB adapter, whether the testing has been done or not. Given the cost of compliance testing usually runs into thousands of dollars, I find it hard to imagine that \$4 online adapter has actually been tested.

That's why you should be extremely careful about where you buy replacement USB adapters. It doesn't mean you have to stick with the manufacturer-branded options, although they should be the



The Regulatory Compliance Mark combines safety and EMC compliance.



The C-Tick is not an electrical safety guarantee, but good to see anyway.

safest bet – just be sure you buy a reputable brand from a reputable retailer. Sadly, you don't need to search for long to find stories of authorities blaming faulty, poor-quality USB adapters for electrocuting users. Don't risk becoming a statistic to save a few dollars.

CHECK THE CABLE

All that said, getting the USB adapter sorted is only half the battle. You also need to carefully choose the USB cable you connect up your device with. In a hurry, it's easy to reach for the first USB cable you can find – particularly if you've misplaced or forgotten to bring your phone's charge cable with you. But just because a cable has the right plugs on the ends doesn't guarantee you'll get the maximum charge rate.

While the USB adapter and the phone negotiate the current charge rate, those electrons still have to travel over the USB cable connecting the two devices together – and not all USB cables conduct electricity equally.

In an ideal world, every USB cable would be like driving a new Volkswagen ID.R down a gunbarrel-straight highway with the highway patrol having the day off – no speed limits, no holding back. But in practice, good-quality cables are like having the highway patrol monitor your speed along the way, while poor-quality cables are more like climbing a two-lane road over mountainous passes on a ride-on lawnmower.

To be a bit more technical, a USB cable's ability to deliver current is determined by its length and the diameter of its internal wires. All cables have some electrical impediment or 'resistance' measured in ohms per unit length, so the shorter the cable, the less resistance it has. However, thicker wire also has less resistance over the same length.

From that, it should be pretty obvious that a short, fat USB cable would be the best option – the problem is not only do most of us need a cable with enough length to make it useable, thicker wire also costs more money. The major brands generally choose the thickness and length of wire that gives the optimum result (both electrically and financially). However, it doesn't guarantee every USB cable maker thinks the same way.

One simple way to test your USB adapters and cables is to purchase a USB voltmeter – you'll find these on Ebay for around \$4. They're usually accurate to within 2%, handle voltage of 3-9VDC and current up to 3-amps, but all models are different, so check before you buy. An alternative that works for more recent phones is the Google Play app called 'Ampere' – it reads the current measured by the phone's internal

Samsung's Galaxy Tab A 10.5 tablet included the Adaptive Fast Charger.



circuitry, provided that function circuitry exists in the phone.

HOW TO TEST

The way you test your combination of phone, adapter and cable is to plug the voltmeter into the USB adapter's USB socket, plug the USB cable into the output of the voltmeter and the other end into your phone (if the mains socket position means you can't see the voltmeter output, plug the USB adapter into a mains extension cable – don't use a USB extension cable).

There's one other tip – the charge current is also dependent on the charge state of the battery itself. Phones will generally charge at maximum rate from about 1% to below 70% capacity, but between 70 and 80%, the rate typically begins to drop back. By the time the battery nears 100% capacity, the charge rate is a comparative trickle.

So to test the capabilities of your USB adapters and cables, ensure your phone's battery is roughly 50% full – that way you'll get the maximum charge rate available.

TESTS - USB ADAPTERS

Here's a quick run-down of my own testing using my 50%-charged Motorola Moto G5 phone and its original USB cable on a number of USB adapters:

- Phone-supplied (2.0-amp) adapter – 1.5-amps
- Third-party (1.0-amp) adapter #1 – 0.99-amps
- Apple 10-watt (2.0-amp) adapter – 1.2-amps
- Samsung Adaptive Fast (2.0-amp) Charger – 1.4-amps
- Third-party (1.0-amp) adapter #2 – 0.38-amps

So from that, the original supplied

USB adapter gives the highest charge rate and, therefore, the fastest charge time.

However, if I was forced to choose an alternative, the Samsung adapter at 1.4-amps would be a much better choice than the third-party adapter delivering just 0.38-amps. How much better? Since it delivers 3.7-times the current, the Samsung adapter would charge up my phone roughly three-and-a-half times faster, despite it not using Adaptive Fast Charging in this case.

TESTS - USB CABLES

To test a number of microUSB cables I had on hand, we took the same phone at a similar 50%-charged state, used the original adapter and measured the charge current:

- Original phone-supplied cable – 1.5-amps
- Third-party cable #1 (30cm) – 1.58-amps
- Third-party cable #2 (120cm) – 0.98-amps
- Third-party cable #3 (180cm) – 0.84-amps

Aside from the original supplied cable, the others show nicely the concept that longer cables have greater resistance and lower the charge current they can conduct. While cable contestant #3, a thick white moulded type stamped 'shielded USB 2.0 high-speed', looked good, the charge rate was little more than half that of the original cable – which I wouldn't have known initially without testing it.

Hopefully from all this you've learned two things – first, USB cables and adapters are not created equal and second, whatever you do, don't lose your genuine adapter or cable! ■

Create an information radiator with DAKboard

Les Pounder shows us how to create a low-cost, Raspberry Pi-powered family calendar using an old monitor.

The term 'information radiator' is a typically obscure tech way of saying 'device that displays information on a screen'. This information can range from simple news feeds and adverts to complex service status. They are typically used in hotel lobbies to display news, weather and adverts, and in tech offices where developers need to see the status of their work at a glance.

In this project we're going to make our own simple information radiator using DAKboard and a Raspberry Pi. The best type of Pi for this project is any of the Pi 3 models or a Pi Zero W, as they all come with built in Wi-Fi connectivity – but if you have an older model you can easily add your own Wi-Fi dongle.

DAKboard is a customisable display – available as a physical device, or just as a service – that can show photos, RSS feeds, weather and calendars. To start using DAKboard, sign up for a

free account at <https://dakboard.com> and then log in. The first screen we encounter is called Screens, and here we can manage a number of them. For this tutorial we'll edit 'My Predefined Screen' so click on it to start editing.

The first task is to set the layout of the screen, so try out a few options. Simply click an option and then Save Changes. In the top right of the screen is 'View Screen': open this in a new tab and it will display your screen. There should be a large image on the left and a black space on the right. In the bottom left is the weather. All of these options will be edited later; for now, just change the layout to 'Big Calendar'. The next step is to alter the background image, so click Background and in the new screen click Source to choose the source of your images. We're going to use Instagram as the image source, specifically images from the Raspberry Pi Foundation. In Instagram Settings, add the user

rasberrypifoundation and click Save Changes. Now go back to the tab we opened earlier and click refresh to see images from the Raspberry Pi Foundation's Instagram feed.

Moving on, we can set up our calendar. In this case it is the LXF Family Calendar, reminding the team to make the tea, drink beer and do work (not in that order though – Ed). First we enable the calendar and set it to show seven days' of content at once. In the Calendars section, we provide an iCal URL, which in this case is from a Google Calendar we set up for this tutorial.

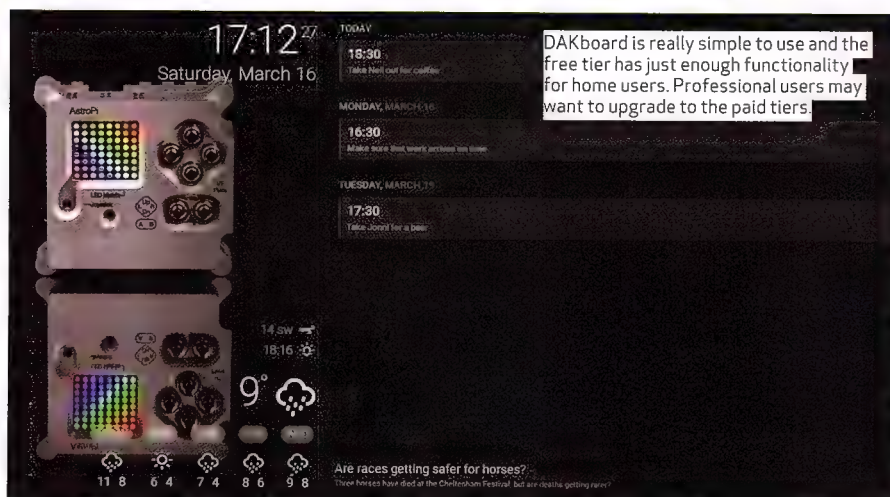
To get the iCal URL for a Google Calendar, open Google Calendar and then click the three dots next to the calendar. Click 'Settings and Sharing', scroll down to 'Access Permissions' and click 'Make this calendar public'. Now scroll down to 'Public Address in iCal format' and copy the URL below it. Paste this URL into the Calendars section in DAKboard, and give the calendar an appropriate name. Click on Save Changes and then go back to the other tab and refresh to see the calendar appear.

In the next section we can alter the time and date according to where we are in the world – this is pretty self-explanatory. Next, we configure the Weather tab, where can set the source of our weather data to one of three providers. For this tutorial we'll set it to OpenWeatherMap and then set the location to where we live – DAKboard will help you find the nearest location. We set the units to those required, in our case Celsius. We lastly set the extended forecast to five days. Click Save Changes and then go back to the screen tab, click refresh to see the results.

FEED ME

The next step is to add a news feed to the screen and for this we go into News and enable 'RSS'. In the News Feed URL, we paste the 'Top Stories' news feed from BBC News, which can be found at www.bbc.co.uk/news/10628494 – but feel free to

"The best type of Pi for this project is any of the Pi 3 models or a Pi Zero W, as they all come with built in Wi-Fi connectivity – but if you have an older model you can easily add your own Wi-Fi dongle."



Photo/Background Settings

Source  **instagram**

Change Photo Every 2 minutes

Brightness 
Adjust the brightness of the background. Lower brightness makes them easier to read.Show Meta ☒ Show photo meta info (title, description, etc.)Crop ☒ Crop to fill the entire screenTransitions ☒ Gradually fade photos in and out

Instagram Settings

Users or Hashtags **raspberrypifoundation**

Separate multiple usernames or hashtags with a comma. Hashtags must start with #. DAKboard can only display photos from public Instagram accounts.

The ability to use live images from your Instagram feed means that your family's screens can see images from around the world, as they are posted to Instagram!

use any RSS feed you want. Save Changes and then go back to the other tab, refresh and watch as the news is displayed in the bottom right of the screen.

In the next section we can set up a To-Do list; for this we've used our Todoist account, which was easily linked to DAKboard via a short wizard in this section. Then we chose the correct list to show, in this case our to-do list for today. Click Save Changes and then go back to the other tab and refresh. You can see the list appear at the left of the screen, just under the time and date.

With all of the configuration complete, go to 'Settings & Defaults', give the Screen a name and click Save Changes. Now write down the Private URL link as we will need this later. Also, do keep this link private...

PILITE

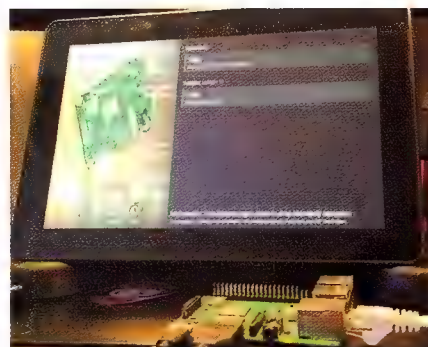
Our Raspberry Pi will need the latest Raspbian Lite release. This gives us the bare operating system and a web browser, ideal for our needs. We also need an internet connection in order to load the DAKboard screen. On the Raspberry Pi we open a terminal and edit a file that enables the web browser to automatically open when the operating system starts. In the terminal, type the following command and press Return.

```
# sudo nano /etc/xdg/autostart/RPI-LXF.desktop
```

We are going to create a config file that creates a desktop entry for an application. This will open the Chromium browser when the desktop loads, set the window size to 1920x1080, and specify fullscreen

kiosk mode to prevent anyone exiting the application. It will also suppress error messages and run in incognito mode. Remember your DAKboard private URL from before? Replace PRIVATE URL FROM DAKBOARD with that address in the following:

```
[Desktop Entry]
Type=Application
Name=RPI-LXF
Comment=Information Radiator
NoDisplay=false
Exec=chromium-browser
PRIVATE URL FROM DAKBOARD
--window-size=1920,1080
--start-fullscreen
--kiosk --incognito
--noerrdialogs --disable-
translate --no-first-run
--fast --fast-start --disable-
```



Information radiators come in all sizes. Here's our test setup using a 10-inch screen that handily reminds us of key information.

```
infobars --disable-
features=TranslateUI --disk-
cache-dir=/dev/null
NotShowIn=GNOME;KDE;XFCE;
```

If you want to know more about what these command line arguments do, especially in the Exec= line, have a look at the Raspian Lite documentation – there are some very handy commands in there.

To save press Ctrl-O, then press Return, then Ctrl-X to exit. Still in the terminal, our next step is to edit a file that will prevent the display from blanking after five minutes. In the terminal, type:

```
# sudo nano /etc/lightdm/lightdm.conf
```

In the file look for the line

```
#server-command=X
```

Change it to

```
server-command=X -s 0 dpms
```

To save press Ctrl-O, then press Return, then Ctrl-X to exit. Now reboot the Pi and once it has successfully rebooted to the desktop, it will automatically load our DAKboard screen!

There you have it: our own information radiator for the home, office and datacentre. ■

Rotating the display

Your information radiator will most likely be in landscape orientation, just like the monitor on your desk. But what if you want to show off your DAKboard using a portrait display? Well, rotating the screen is quite simple – perhaps not as simple as on Ubuntu/Fedora desktops, but all it requires is a little basic terminal work. In Raspbian, open a terminal and type:

```
# sudo nano /boot/config.txt
```

Scroll to the bottom of the file and add the following two lines:

```
#ROTATE HDMI
```

```
display_hdmi_rotate=X
```

Change the X to 1 for 90 degrees, 2 for 180 or 3 for 270 degrees. To save press Ctrl-O, then press Return, then Ctrl-X to exit.

Reboot the Raspberry Pi and your display should now be rotated and ready for use. If the effect is not as desired, change the value of X to another number between 0 and 3. To turn off the rotation, just add a # to the start of the line and the system will ignore it.

Scikit-Learn: the ultimate Python library

Want to master machine-learning in Python? Get scikit-learn into your system and you won't go wrong. Darren Yates explains how it works and examples you can download.

Python is one of the world's most versatile programming languages and one of its prime uses is machine-learning. Recently, we created a decision tree model on a training dataset of Iris plants to identify the plants by the dimensions of their flowers. The key component in that process was the popular machine-learning library, 'scikit-learn'. If you want to grow your machine learning skills, there's no question scikit-learn has to be on the top of your tech bucket list. So, this month, we're giving you a head start – we'll look at how to install it, how it works and look at some cool facial recognition examples.

INSTALLATION

First things first, if you don't have Python, get it now from python.org. You'll need at least version 3.5, but get the latest version 3.7 just to be safe. Grab the self-installer version for easy installation. When you've installed it, go to the installation folder. In Windows, this should be

`/Users/<name>/AppData/Local/Programs/Python/Python3x.` Now open the 'scripts' subfolder, launch a command prompt here (do this in Windows Explorer – hold the left shift-key down, right-click in the folder empty space, choose 'Open Command Window Here'). Now run the command:

```
pip install sklearn
```

The 'scikit-learn' package relies on two other important numeric libraries, 'numpy' and 'scipy' – these should get install automatically if they're not already during the scikit-learn install. Other useful libraries you can also install using the same 'pip install'-style command include 'Matplotlib' (for plotting graphs) and 'pandas' (for making custom data structures).

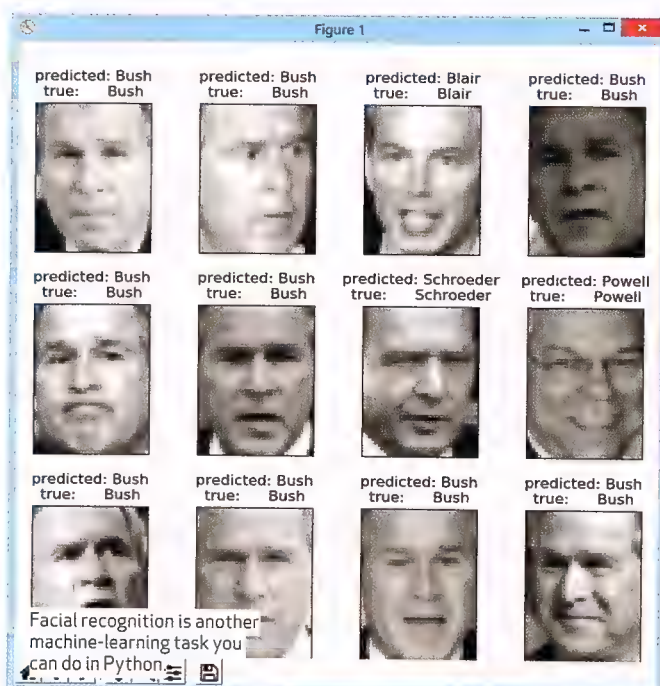
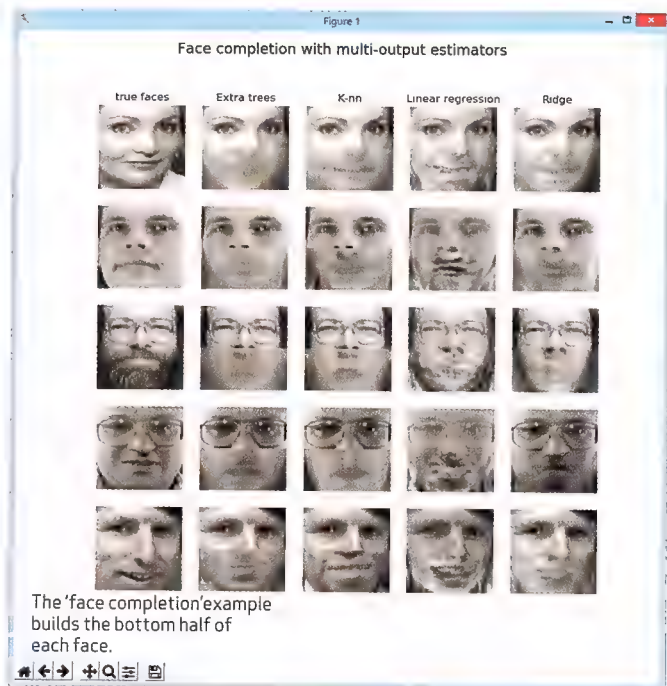
WHAT IS SCIKIT-LEARN?

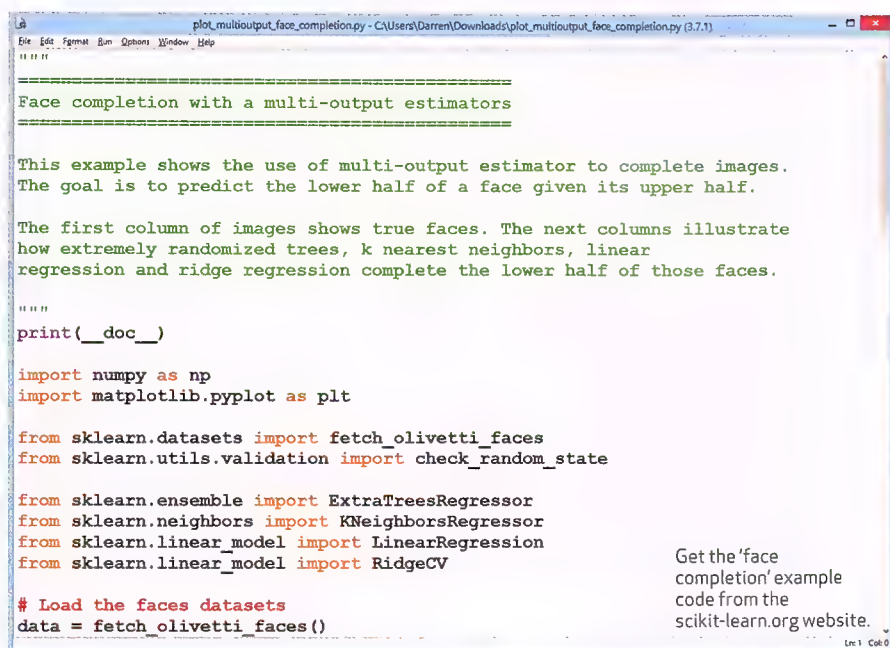
The scikit-learn library is Python's multi-layer toolbox for all things machine-learning. It allows you to create your own machine-learning scripts to build models that summarise large datasets of data. Basic machine-learning tasks generally fall within

two main categories, 'supervised learning' and 'unsupervised learning'. Remembering that most data comes as a two-dimensional spreadsheet, with repeated events or 'records' in rows and attribute of those events in columns, what separates supervised from unsupervised learning tasks is whether or not the dataset as a 'class' attribute, a category each record belongs to. If it does, the learning is supervised by those class attribute values. If there's no class attribute, it's an unsupervised learning task.

Supervised learning tasks are divided again into two subgroups based on whether the class attribute values are categories (for example, days of the week) or numeric (age, wage etc). If they're categorical, you perform a classification task; if they're numeric, you carry out a regression analysis.

Scikit-learn contains dozens of machine-learning algorithms to handle all three major tasks. Why so many? Because the ideal algorithm that models every dataset perfectly doesn't exist. For example, one classification algorithm might be good at smaller





scikit-learn package. From there, you load the dataset into a variable, then execute the classification algorithm on that dataset.

EXAMPLE - FACE COMPLETION

There's an impressive example you can download and load into Python from the scikit-learn.org website (tinyurl.com/y4ofgkbf) called 'Face Completion' – and it's pretty cool. Given a set of low-resolution face images, the code learns a model that, given the top half of a face, tries to reproduce what the bottom half should look like. Grab the code, load it into the Python IDLE editor and press the 'F5' key to run it.

On first run, it has to download the set of images, so it'll take a bit of time, but it'll then produce a series of images showing the original faces on the left, followed by the outputs of four different regression algorithms – Extremely Random Trees, K Nearest Neighbours, Linear Regression and Ridge Regression.

After looking at those images, chances are you might not be too impressed by the result. However, remember this – the model was built by learning one set of images, but the images you see have not been seen by the model before now, so it's trying to build the bottom half of each face based on what it previously learned. It's also learned from just 400 images in total, so it's a tiny set.

EXAMPLE - FACIAL RECOGNITION

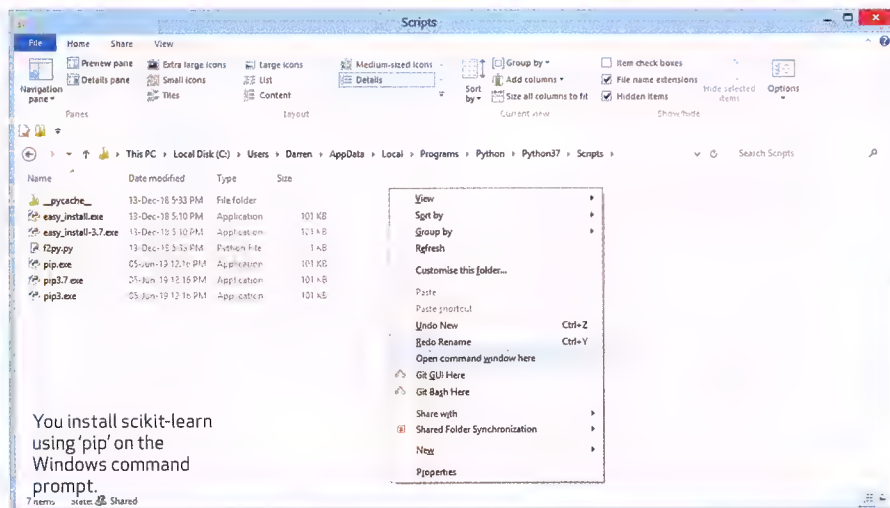
One of the hot-button topics for machine-learning at the moment is facial recognition and scikit-learn.org has an interesting example you can download at <http://tinyurl.com/yxmqsoxh>. Here's how it works – it takes a series of images of well-known people and performs 'principle component analysis' (PCA) to find the 150 most important attributes that determine facial structures. A model is then constructed based on that and tested on a separate 'test' set of images. The results are pretty impressive – the model can pick former U.S. president George Bush 86% of the time and former British prime minister Tony Blair with 81% accuracy.

One tip – you'll need to install the Python Imaging Library (PIL) to get this to run correctly. However, PIL has been taken over by the 'pillow' library, so use the following install command:

```
pip install pillow
```

Then, run the facial recognition example.

Machine-learning is arguably the fastest growing segment in tech today and understanding even the basics through boosting your knowledge of Python will do your future employment chances no harm at all. ■



datasets, another at larger sets. Yet another may give more accurate classifications, while a different algorithm may give faster results on devices with constrained hardware devices (think 'internet of things').

Decision trees are a popular and easy-to-understand type of classification algorithm – there are many hundreds of them developed and published in research. I've even had my own published called 'SPAARC' (split-point and attribute-reduction classifier). But you can move into multi-tree or 'ensemble' algorithms, such as RandomForest, Bagging (Bootstrapped Aggregating) and swag of others.

MODEL TESTING

Once you've built your model, scikit-learn can then test it for you using a number of different techniques. The most common is known as 'n-fold cross-validation'. In short, it divides your dataset into 'n' (say, ten) groups. A model is built using nine of the ten

groups and tested with the tenth. This is then repeated another nine times, but with each group taking a turn at being the testing group. The ten results are combined and the proportions of correctly-classified records are combined as the classification accuracy percentage. It's ideally suited to smaller datasets where you don't have the luxury of being able to create separate use-once 'train', 'test' and 'validate' subsets.

USING IT IN PYTHON

The scikit-learn library follows standard Python conventions for inclusion into your code. So, for example, to load one of the built-in toy datasets, you begin with:

```
from sklearn import datasets
```

If we wanted to test using the RandomForest algorithm, for example, we'd also include:

```
from sklearn.ensemble import RandomForestClassifier
```

Both of these statements import functions from various parts of the



E3 2019: on the edge of huge change

What does the year ahead in gaming hold? Shaun Prescott foretells an eventful time.

If E3 2019 had a theme, it was that 2019 is a year at the threshold of seismic change for the games industry. The convention, which took place in Los Angeles in early June, risked feeling underwhelming due to the unusual absence of Sony (not to mention showroom floor activities from the likes of EA and Activision). But as we approach the release of next-generation consoles in late 2020, it feels like everyone's bracing for what comes next. E3 2019 felt like the coy beginnings of the next-gen sales pitch.

CONSOLE WARS: 2020

Streaming and services are definitely in our future. While Sony revealed the first details of its next PlayStation console earlier this year, it was very specs oriented. Microsoft, on the other hand, is doubling down on its Xbox Game Pass subscription model, with that service now available on PC. Phil Spencer told IGN after the conference that the focus of Xbox isn't on console sales but "selling software and services". The company did offer a few details about its 2020 console: it'll support 8K resolution and 120 frames per second performance, and like Sony's next console, will boast an SSD. But Microsoft is more concerned with

welcoming people into its services ecosystem: it doesn't really care what hardware you're using to access its software platforms. So far, Sony hasn't revealed any details about bolstering its PlayStation Now subscription service in order to catch up – if it intends to do so at all. The service isn't even available in Australia yet. Sony rose to the top of the PS4/Xbox One generation by changing up as little as possible, but it's yet to be seen whether a) that's their strategy for 2020 or b) if it is, whether it'll work again for them.

It's looking more and more likely that we won't technically "own" games anymore, though you could argue that's the case already for digital purchases. Streaming via cloud using technology like Google Stadia, or else downloading from a smorgasbord ala Xbox Game Pass, is clearly where the industry wants to go. And video game companies have a history of forcefully dragging their customers in directions they might not necessarily want to take (see: loot boxes, DLC and more).

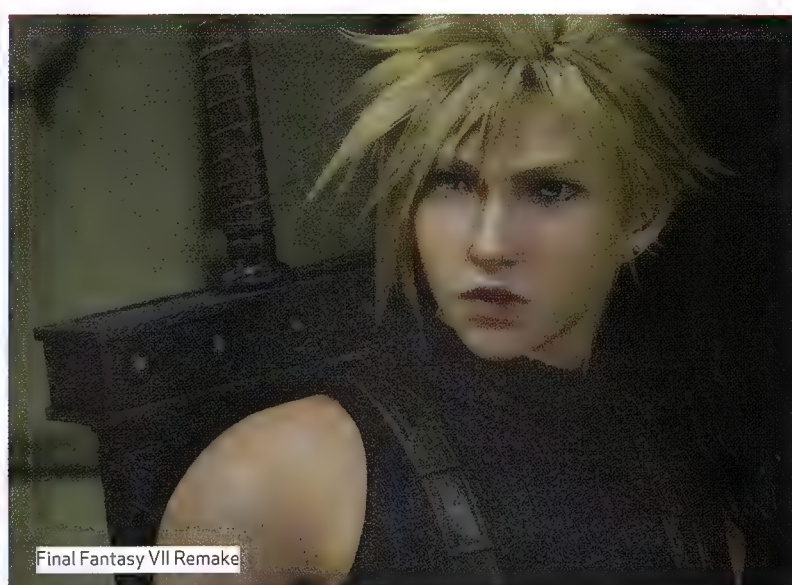
SHOW STEALER

Whatever the case, E3 2020 will almost certainly be dominated by next-gen, so most of the software shown or revealed at this year's convention was either stuff we

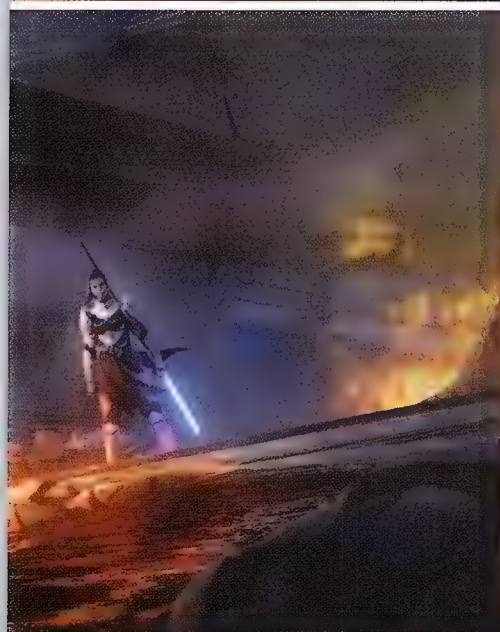




Cyberpunk 2077



Final Fantasy VII Remake



Ghostwire Tokyo



already knew about shown in detail (*Cyberpunk 2077*) or else decent and unsurprising (*Watch Dogs 3*). There were exceptions: From Software, the Japanese studio famed for its *Dark Souls* and *Bloodborne* games, will collaborate with George R.R. Martin on *Elden Ring*, a game that promises to expand the studio's well-worn action RPG template. Rather than the usual *Metroidvania* map design, *Elden Ring* will take place in a sprawling open world. For any other studio, that would seem an obvious direction, but given From Software has released six critically-acclaimed games since 2011 all boasting roughly the same design principles, it's easy to see why it was the highlight of the show.

That's a single-player game, by the way, and in the wake of fairly meagre performances by the likes of *Anthem* and *Fallout 76*, the 'games as services' trend seems to be in limbo at the moment. While Marvel's *Avengers* looks set to follow that template, publisher Square Enix took pains to point out that it could be experienced alone, and most of the convention's other software highlights were single-player: *Jedi Knight: Fallen Order*, *Watch Dogs 3*, *Cyberpunk 2077*, *Elden Ring*, *Final Fantasy VII Remake*, *Doom Eternal* and *Zelda*, to name a few.

MICROSOFT GOES BIG

As for the press conferences themselves, Microsoft's was the most exciting, what with its talk of next-gen hardware and the largest array of first-party exclusives the company has had in years. Electronic Arts spent most of its hour talking about *Star Wars*, and Ubisoft had the usual bunch of familiar names in new skins: a *Rainbow Six Siege* alien spin-off, a new *Watch Dogs*, and *Ghost Recon Breakpoint*. It did unveil a new live online game called *Roller Champions*,

which appears to borrow heavily from *Rocket League*. But as a live service game it hardly set the world ablaze: the antipathy towards that model is thick as cheese among consumers at the moment.

BETHESDA STRUGGLES

And that was no better demonstrated than during Bethesda's press conference, which saw Pete Hines and co spend an awkward amount of time grovelling to *Fallout 76*'s easily infuriated playerbase. The company attracted unprecedented ire for its live service take on the *Fallout* formula last year, and much of Bethesda's conference felt like disaster containment. It felt slightly gross to watch a company respond to what often amounted to abuse with saccharine platitudes, but... what else were they going to do? And besides, the press conference was surprisingly successful despite the promised no-show of *Elder Scrolls 6* and *Starfield*: a new *Arcane* game called *Deathloop* was a highlight, as was a new game by Shinji Mikami's Tango Gameworks studio, the sci-fi horror *Ghostwire Tokyo*.

Again: those are all single-player games. With the emergence of a viable subscription model and the looming launch of Google Stadia, is it possible that single player games will start to dominate once again? Well, that already appears to be the case, but no one spent a great deal of time talking up live service or multiplayer games at E3 2019, and given the fact that 10 hour games don't exactly feel like money poorly spent when they're consumed as part of a small monthly fee, maybe – as we saw with *HBO* – they'll undergo something of a renaissance. Whatever the case, all of these speculations will surely be substantiated this time next year. ■



\$55 | PC | WWW.UBISOFT.COM/EN-GB/GAME/ANNO-1800

Anno 1800

A compelling if somewhat idiosyncratic city-builder.

This is comfortably the most engrossing city-builder I've played since *Cities: Skylines*, one that combines an intriguing theme with some enjoyably complex production chains and trading mechanics. It also has a wealth of buildings to construct and resources to produce, letting you create some truly impressive and enormous urban sprawls.

Anno 1800 puts you in the hobnailed boots of an up-and-coming business magnate in the burning heart of the industrial revolution. There are three ways to play: Campaign, Sandbox, and Multiplayer. Structurally, they're all basically the same – the campaign is itself a gigantic sandbox that happens to feature a chain of missions to follow.

Whichever way you choose to play, you start out in charge of a western-

European island with nothing but a trading post to your name. Your first goal is to build a simple farming village, which acts as the foundation for your city. From here, your objective is to grow a bustling metropolis that will stretch its tendrils to the horizon and beyond.

In its early stages, *Anno 1800* is a straight-up city-builder. Progress in *Anno* is predicated upon two things – population growth and meeting the needs and wants of your citizens. Each “class” of person has a different set of requirements that you need to meet. Farmers, for example, simply require clothes and fish to subsist. But to make them happy, you need to ply them with alcohol (just like real life!). You'll need acres of potato fields that can be distilled into schnapps, while also ensuring all farmsteads are

within staggering distance of a pub.

The better you meet those needs, the more people will fill the houses of your village. Once a farmhouse reaches its maximum population, it can then be upgraded to house the next class of citizen – workers. This unlocks the next evolutionary stage of your settlement, letting you construct more advanced buildings like brickworks and breweries.

Once you unlock the third tier of citizen, artisans, you'll need an infrastructure capable of supporting the production of sewing machines, fur coats, and rum. The latter of these, of course, requires raw materials that don't grow in a European climate. So to acquire these, you need to build ships and send them to explore the New World.

The New World is represented on an entirely different map, and has

unique citizen types, production chains, and resources. This effectively means a game of *Anno 1800* plays out on two unique RTS maps at once, which has all sorts of tactical considerations.

Anno 1800 is a rich and sumptuous city-builder, easily the grandest and deepest *Anno* to date. Its early game is a wonderfully relaxing experience, while the later stages will have you scratching your mutton-chops and happily stretching your braces in equal measure.

■ Rick Lane

Verdict

Despite an annoying story mode, *Anno 1800* is the biggest and best entry in the series to date.





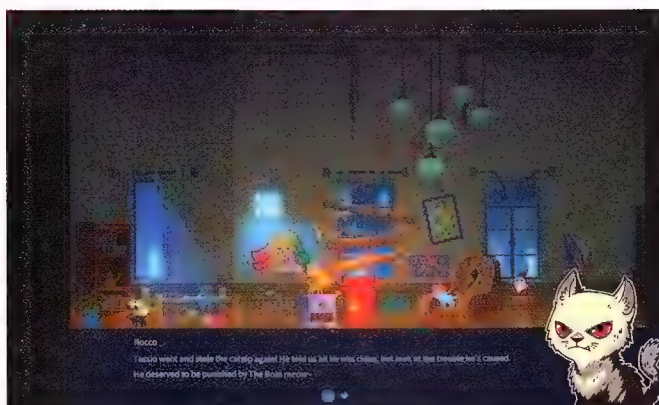
\$24 | PC | WWW.ZODIACINTERACTIVE.COM

Tales of the Neon Sea: Chapter 1-3

In this world the future is puzzling.

Tales of the Neon Sea borrows from well-known cyberpunk sources but, alongside its brighter aesthetic, it takes a deeper look at the technical aspects of cyberpunk, rather than the moral ones. The plot itself is conventional. One day the alcoholic augmented P.I. Mr Mist stumbles onto the corpse of his elderly neighbour, well-known for her hate of androids. At first the case seems clear: the household android must have done it. But the evidence you uncover paints a much more gruesome picture. Weirdly enough, you're not so much interested in the killer as you are in the android and what could have driven it to become a possible accomplice. And so you dive into the underworld to find out more, aided by the helping paw of Mr Mist's stray cat friend William. The influence of organised gangs of cats in our future is underrepresented.

Neon Sea isn't trying to be narrative-focused – long stretches of game time pass with nary a word – instead it offers fantastical



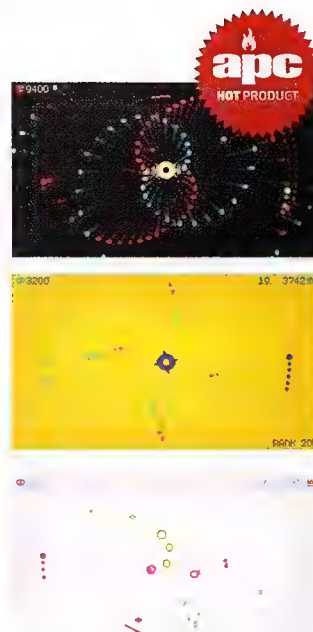
technology and lets you mess with all the various machinery and automatisms that run a city. At its most basic, the game assumes that in a future filled with different contraptions, a whole lot of it will be in disrepair. Chances are that any classic environmental puzzle you've ever solved in a game appears in Neon Sea in some way. A lot of it requires you to have your hands deep in the innards of a machine, fixing circuitry or reconnecting valves. This can sometimes feel as if a familiar type of puzzle has simply gained a coat of cyberpunk paint.

How good you are with valve and lever puzzles should tell you how much

you will enjoy yourself. I had fun with it all, surprised by interesting variations of the same puzzle mechanic, but I can't help but think a lot of potential was squandered due to the relentless pace of puzzling at the expense of narrative. It's entirely too easy to forget you're supposed to solve a murder with all the puzzles burying an otherwise interesting case. ■ Malindy Hetfield

Verdict

A lovingly crafted adventure slightly let down by structure and writing.



Breaker

If you break it, you don't pay for it.

FREE | PC, MAC | MANAGORE. ICH.IO/BREAKER

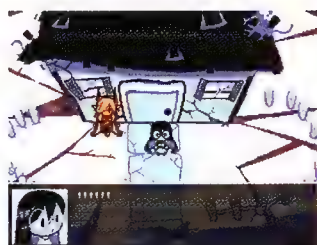
As in the arcade classic *Breakout*, in *Breaker* you play as a sort of featureless paddle-thing here, without the ability to fire your own bullets. Instead, you have to repel enemy spaceships' projectiles back at them, as you rotate around a circular playing field. Even without the devious colour twist, *Breaker* would be a satisfying shoot-'em-up, with fluid, kinetic pixel art, and one of the best soundtracks I've heard all year.

As bullet-hell-style games go, this is also one of the more approachable, peppering the screen with only handfuls of bullets at a time, while giving you plenty of empty space with which to manoeuvre yourself out of trouble. You can absorb a few hits before the Game Over screen appears, and you'll even recover a bit of health after defeating bosses.

I think the developer is being modest in declaring its arcade inspirations, as *Breaker* is hardly a clone of the classics I mentioned. It can stand proudly next to the formative shoot-'em-ups that influenced it.

■ Tom Sykes





Escaped Chasm

One way to feel blue.

FREE | PC, MAC | TUYOKI.
ITCH.IO/ESCAPED-CHASM

Here's a short, sad game from *Undertale* artist Temmie Chang. You play as an unnamed girl who has developed a fear of leaving the house and strange things have started happening. For one thing, a mysterious traveller has appeared, spouting cryptic messages about her missing mum and dad. For another, her house appears to reside inside a gradually collapsing void. To put things right she'll need to make a terrible choice, with no real clue what the repercussions might be.

There's sadness everywhere, from the distinctly blue colour palette to the mournful soundtrack and the girl's almost heartbreaking interactions with her environment. You examine her pet snake, and of course it's nearly dead. You look at pictures of her parents, who left her all alone. The TV, with its daily snippets of cartoons, is really her only friend here. You'll desperately want to get her out of the house, even if you have no idea where she'll end up. The multiple endings – for all their mysteriousness – do deliver, in a pretty cathartic way, on that. ■ Tom Sykes



\$42 | PC | WWW.RISEOFINDUSTRY.COM

Rise of Industry

A beautiful but aimless sandbox.

The first thing you'll notice upon playing *Rise of Industry* is that it's absolutely gorgeous. The boxy shapes and flat colours of the low-poly style are a perfect fit for the city/factory builder genre. This, combined with bright colours and sticker-like icons, makes the game looks less like a real city and more like a child's play set. Unfortunately that's also how the game plays, like a toy. Something that's fun to play with, but lacks direction.

It's fundamentally about supply and demand. There are a handful of towns of various sizes spread across the map, each of which has two to four stores which will buy a certain good. Your job is to fulfil that demand. This can be as simple as mining some coal and shipping it directly to the hardware store, or as complicated as the pizza, a puzzle of a product that requires mills producing flour, vegetable farms and a dairy producing cheese.

Eventually things get a little bit more complicated, with the player getting access to heavier trucks,



trains, boats and even zeppelins to haul products and set up long distance supply chains across the map. The only problem here is I didn't feel enormous pressure to use them. You see, resources are spread so evenly across the map it seems just as easy to build a new manufacturing facility near your destination as it is to set up a railway line.

It also doesn't help that the "campaign" is what I would usually consider a sandbox mode, while the actual "sandbox" is just the same thing but with infinite money and everything unlocked. There are AI competitors, but they don't seem to add much beyond being a nuisance when they

buy exclusive rights to build in an area I was targeting.

How much you'll enjoy *Rise of Industry* is largely going to depend on how capable you are of making your own fun. The interactions are very strong, but the only goal the developers offer is creating an endgame product. There's no real capacity for expression and creativity.

■ Tom Hatfield

Verdict

Beautiful and polished, but ultimately it just runs out of things to do after a while.





FROM \$84.95 | PC, PS4, SWITCH, XB1 | MORTALKOMBAT.COM

Mortal Kombat 11

Sets the standard for storytelling in fighting games.

The stuff that defines *Mortal Kombat* is here in gore-soaked, self-aware spades. The fighting is the best it's ever been. The fatalities are sickeningly inventive. There are enough unlockables to keep you busy for ages. But it's the story mode that stands out, putting together 27 years of MK lore into something that's like the best bits of a Marvel movie.

The new villain, Kronika, feels like Thanos and Galadriel's lovechild. Her plan is to rewrite time to prevent an authoritarian Raiden from upsetting the balance of the universe by beheading Shinnok. It's an effective, morally-ambiguous setup, similar to

what NetherRealm did with *Injustice*. The temporal gymnastics also mean that classic versions of the game's heroes return, alongside the revenant versions seen in MK X. It's an absolute thrill for anyone who's followed the series, and it's a smart way of starting afresh. Some moments, such as Jax wrestling with his past as a revenant, are surprisingly poignant. Others, like Johnny Cage bickering with his asshat younger self, are just plain funny.

None of this would matter if the fighting was guff. But this is as immediate, engaging, and rewarding as the series has ever been. It still has the same pick-up-and-play ease of previous

MK games, but it's easier than ever to drill into the specifics that make this a competitive fighter. Many elements have been refined. Instead of endless X-ray moves, we now have Fatal Blows – powerful one-shot attacks you use when your health is low. They can turn a losing round in your favour, but they can only be used once per match if they connect.

There's a deep level of customisation for each fighter. Skins, gear, entrances, abilities, and even AI behaviour can all be tinkered with, using unlockables earned by playing the game or exploring the Krypt mode. The latter is a third person adventure in which your generic explorer plunders Shang Tsung's island, knocking down crumbling walls and opening chests.

■ Matt Elliot

Verdict

A deep, customisable fighter with superb narrative.



Penumbra

Where everything's a scream.

FREE | PC, LINUX, MAC |
ADAMBEHL.ITCH.IO/
PENUMBRA

This horrific puzzle game will have you stroking your chin one moment and jumping in fright the next – an inspired combination, if not an especially palatable one. The story's enjoyably mysterious. You wake up at a snowy dig site housing an ominous, 2001-style monolith. Like all the best monuments, this one's rich in mystical energy, transporting you to a surreal realm full of spatial puzzles and supernatural creatures. But the puzzles are well-implemented, and fairly original, comprising a series of deceptive environments that have to be traversed in a very specific manner. There's also a giant spider in one area that serves as *Penumbra*'s minotaur, a skittering arachnid that scampers about while you fathom a difficult maze. If it gets you, you're thrown back to the entrance, and you just had to endure the most horrible sound. I don't know about you, but that's a level of pressure that I don't find terribly conducive to the puzzling process – although admittedly, it does transform a basic maze into a deadly game of cat and mouse. ■ Tom Sykes





Falcon 3.0

Anthony Fordham on the most influential combat flight sim of the 1990s.



GAME: Falcon 3.0

DEVELOPER: Spectrum Holobyte

RELEASED: 1991

NUTSHELL: Despite not having textures, it brought (claimed) military-grade flight modelling to the PC, with such extreme prejudice that for the first time, it made people upgrade their computers just to play this single game.

The PC didn't become the tech-leader for gaming just because of hardware. After all, what's the advantage of a PC that can play games just as well as other platforms, if it costs five times as much? The PC needed to show there was a reason for all that grunt. And at the dawn of the 1990s, that reason was the PC owner's thirst for insanely detailed combat flight simulators.

For the first few years in the market, gaming on an 8086-based, "IBM-compatible" PC was a distraction, like playing *Snake* on a Nokia 3210. But when Intel released the 386 in 1985 PC gaming entered its first important Golden Age.

Almost overnight, the 386 made the PC the most powerful and capable home platform, so all it had to do was win the hearts and minds and wallets of Amiga 1000 and Atari ST owners to realise its destiny as the true home – the only home – of the newest and most technically complex games.

To win those wallets, PC had to show there were games that the Amiga and Atari couldn't run. Games the kinds of people who spent \$7,000 on a Compaq DeskPro would think

worthy of their superior intellects. Thus: the flight simulator.

OBSESSIVE DEDICATION

Sure, other platforms had, shall we say, aeroplane games. And more power to them. The world would be a poorer place without *Afterburner*. But the PC allowed actual flight simulation. As in, games where everything took a back seat to modelling the flight dynamics and operation of an aircraft, as close to reality as possible.

We'll revisit *Microsoft Flight Simulator* (and its cooler younger brother *Combat Flight Simulator*) in a later Game Changer trip, but I mention it not just because of its dad-cool domination of the space, but also because it reflects the core philosophy of PC flight simulation: obsession.

Obsessive creators, obsessive players. Case in point: In 1987, a mob from Palo Alto called Spectrum Holobyte, released a flight sim called *Falcon*. It focused on the General Dynamics F-16 Fighting Falcon (obviously) and was an early example of a flight sim that made gamers say "wow, flying a jet fighter sure is hard work but I am worthy!"



GONNA NEED A BETTER PC

But *Falcon* was also ported to the Amiga and Atari because there just weren't that many PC gamers to keep a developer afloat, back in 1987. Even worse, the Amiga and Atari editions were arguably better – they had a very early implementation of the idea of a “dynamic battlefield”, where stuff you blew up in one mission stayed blown up in the next.

By 1991 though, the tables were turning. There were even more PC brands available, prices of 386-based machines had descended from astronomical, through cislunar, to merely stratospheric, and there were now enough PC gamers to justify exclusive titles.

Not that Spectrum Holobyte's magnum opus was deliberately exclusive. *Falcon 3.0* (*Falcon 2.0* was called *Falcon AT* and it ran in EGA, so, moving on) shattered paradigms. Spectrum Holobyte embraced a concept that would serve developers well for at least the next 15 years: we don't care what PC you have. If our game won't run on yours, you need to buy a better one.

THE ENDLESS UPGRADE CIRCLE

The editor of this magazine bought a better one. He agonised over whether he could justify spending all of his

money on a 386, or all of his money plus some additional money he'd have to get somewhere, on a 386 with a math coprocessor.

Falcon 3.0 used – or at least Spectrum Holobyte claimed it used – flight data from military simulators. What does that mean? It meant the game had a “high fidelity flight mode”. And that basically meant *Falcon 3.0* did more maths, thus the agonising over the math coprocessor – not having one in your PC meant high fidelity mode was locked out.

So what was *Falcon 3.0* like to play? As far as anyone who bought it could tell, it was like trying to fly an actual F-16 using a consumer-grade joystick and a keyboard. That the F-16 really does have a highly computerised control system (it was the first

fly-by-wire combat aircraft) certainly means that in principle, it should be possible to simulate exactly how the real jet would respond to any given control input.

In practice, of course, *Falcon 3.0* had to work within the limitations of the 386 and 486 platforms. Resolution? 640x400. FPS? Not really a thing. Textures on objects? Not invented yet.

But because the PC could do numbers, so many numbers, it made the collection of geometric shapes that vaguely resembled an F-16 fly like an F-16. Real F-16 pilots could sit down and go “haha, yeah okay I know my way around this.

A BIG SKY OF MANY BIRDS

Falcon 3.0 showed that the PC could be serious (realistic simulation) but that this didn't need to mean boring (Cessna 172 at Chicago Meigs ugh).

Since *Falcon 3.0*, the PC has been the only home of the properly serious military flight simulator. Throughout the 1990s and early 2000s, so many shooty-plane-games came and went. They were mostly trend-based. First it was WW2 (*Aces of the Pacific/Over Europe*), then it got really specific in the F-22 (various, including *Gears of War's DICE*), then the IL2-Sturmovik for some reason. Even the SU-27 had a long, long day in the sun.

Flip forward to 2019, and the only real game in town is *DCS* (*Digital Combat Simulator*). All the planes, all the theatres, all the multiplayer F/A-18 missions where everyone but you bombs from 1,000 feet despite you reminding them constantly to bomb from 5,000 feet...

PC GAMING'S GOLDEN CROWN

The technological gulf between *DCS* and *Falcon 3.0* is immense, but spiritually, they're the same kind of software. Combat flight simulators on the PC are one of the few types of games that harness and justify all that power.

The only thing you need to justify is the cost of all the joysticks, pedals, head-trackers, and (these days) VR goggles these games, inevitably, make you want to buy and upgrade more than you rationally need to. ■

WHATEVER HAPPENED TO FALCON 4.0?

Falcon 3.0 used military simulator data to make its flight model as realistic as possible, but it was still a game. *Falcon 4.0* was, straight up, like being in the USAF. In 1998 it looked amazing and ran like a dog's breakfast. Yet its dynamic battlefield and incredible detail meant modders refused to abandon it. From the miasma emerged Benchmark Sims, a team that created new theatres, fixed bugs, upgraded visuals, and did so much to *Falcon 4.0* that its eventual publisher (Atari) sent a cease-and-desist letter. Fortunately, Atari got distracted by its endless financial problems, and BMS exists to this day.



Pakistani politician holds press conference behind a cat filter

Facebook's funny feline filter applied to political livestream.

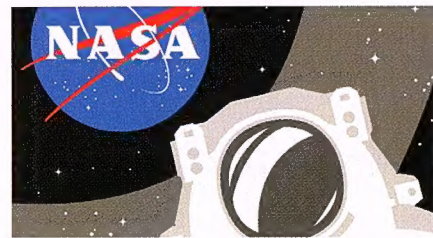
They say any publicity is good publicity, but one regional Pakistani politician put this to the test when he accidentally delivered a weekly press conference behind a Facebook cat mask filter. Shaukat Yousafzai appeared to be wearing whiskers, a fuzzy nose and pink cat ears in a livestream that was posted to his political party's official Facebook page. The mistake was reportedly caused by 'human error' and the party has taken precautions to prevent the activation of comedic filters on future livestreams. While undoubtedly embarrassing, some online commentators are now requesting that all political proceedings be subject to funny cat filters.



AI creates petition to 'put a baby on Mars'

NEURAL NETS USED TO GENERATE 'IMPORTANT' CAUSES FOR PEOPLE TO GET BEHIND.

AI is regularly in the news for taking jobs or overstepping ethical boundaries, so it's nice to see that it's also capable of positive things like exerting its democratic right to petition. Electrical engineer Janelle Shane's novel AI campaign generator was trained on a dataset of change.org petitions in order to come up with a few 'causes' of its own. While there's plenty of nonsense, it's got a few that seem like worthy causes to get behind, including: "Officials at Prince Alfred Hospital: Aurora to Tell The Company To Send A Baby to Mars" and "Help Bring Climate Change to the Philippines".



Hacker uses Raspberry Pi to infiltrate NASA's Jet Propulsion Laboratory

REAL LIFE MR ROBOT SHOTS FOR THE STARS.

While they might be portrayed as the ultimate budget hacker tool, the Raspberry Pi is more often used for pet projects like making your Roomba swear when it bumps into things or building your own retro console emulator. In 2018 however, an unauthorised Raspberry Pi device was connected to NASA's network, creating a vulnerability that was used by remote hackers to access and copy confidential mission information. The breach is believed to have existed for around 10 months with the hackers making off with 500MB of current Mars mission data. Once discovered NASA network security were able to easily unplug the device and patch the breach.

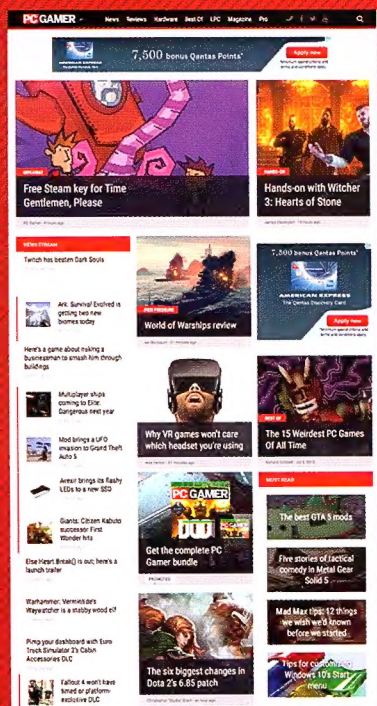


Florida councils pay hackers US\$1.4m ransom after Baltimore reparations reach \$10m

CATASTROPHIC MALWARE INFECTION BRINGS MORE US CITIES TO A STANDSTILL.

Despite estimations that it had already cost the state US\$8 million in direct revenue and US\$18 million in operating costs by June, Baltimore City Mayor Bernard Young hasn't turned back on his refusal to pay the 13 Bitcoin (US\$170,000) ransom to unlock the city's computer systems. While the argument could be made that its negotiation principals will save the government in the long run, the two Floridian states of Riviera Beach and Lake City have since suffered similar attacks, with both councils deciding to pay their respective 65 Bitcoin (US\$841,000) and 42 Bitcoin (US\$544,000) ransoms. Baltimore is now proposing to use US\$10 million in excess revenues to pay for reparations and improved security measures. ■

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